

THE LARYNGOSCOPE.

VOL. XLVIII

JUNE, 1938.

No. 6

DOES ANIMAL EXPERIMENTATION SHOW SIMILAR CHANGES IN THE EAR OF MOTHER AND FETUS AFTER THE INGESTION OF QUININE BY THE MOTHER? (PRESIDENTIAL ADDRESS.)*

DR. HARRIS P. MOSHER, Boston.

I very greatly appreciate the high honor of being chosen President of this old and most distinguished Society.

For quite a few years, Dr. Marshall Taylor has been hammering away with bulldog tenacity accumulating clinical evidence that quinine taken by the mother can cause deafness in the child. I have been impressed, as many of you must have been, by the clinical data which he has assembled in support of his contention.

In looking for a subject to speak to you about today, not being by birth or training a physicist or a mathematician, I chose a subject which required humbler talents, namely: "Does animal experimentation show similar changes in the ear of mother and fetus after the ingestion of quinine by the mother?"

Accordingly, for the past year and a half I have been working at this question. Eleven adult pregnant guinea pigs have been given quinine in varying doses over varying periods, and 21 feti from these mothers examined; three pregnant pigs were given sodium salicylate and seven feti obtained for examination; one pregnant pig was given mapharsen and two feti obtained and examined.

*President's Address, read at the Seventy-first Annual Meeting of the American Otological Society, Atlantic City, N. J., May 5, 1938.

Editor's Note: This ms. received in Laryngoscope Office and accepted for publication, May 25, 1938.

Six adults were not given medication and were used for controls. In all, 54 animals were studied.

The subject of the paper I have just given. The paper itself consists of the presentation of the findings in 54 animals. I shall deal only with the subject of hemorrhage and only with the findings in the guinea pig. By inference I shall imply that the findings would probably be similar in man were like experimental conditions possible. I shall disappoint Dr. Taylor somewhat because I have not proven that any of these animals were made deaf. To do this would take another year, at least. I have been working on this subject only a little over a year. To prove what he wishes to have proven and which I think will in time be proven would mean that instead of sacrificing the mother and fetus, as I did, the fetus would be allowed to be born, to live awhile, have its hearing tested by modern methods, and then be killed. Dr. Lurie, who is working at this type of experimentation, will probably have something to say on this subject when sufficient time has elapsed. As far as I am concerned, Dr. Taylor will have to be satisfied with a lesser favor; namely, I can show that quinine and salicylic acid produce similar changes in the internal ear of mother and fetus, the changes being more marked in the fetus. The initial effect of these two drugs given either in overwhelming doses, or in doses over protracted periods until the animal becomes toxic, is hemorrhage. This may occur in any part of the cochlea, about the basilar artery and even in the medulla.

The frequency with which hemorrhages in the cochlea are found with and without medication speaks for the ease with which they are produced and is the worst feature about them. Only when repeated to the point of the formation of fibrous tissue in places vital to hearing, to the strangulation of ganglion cells, or to the obliteration of a fundamental portion of the blood supply, do they become of importance as a cause of loss of hearing.

ORDER.

The order of the paper is as follows: The method of examination; the ear findings after the giving of quinine to animals, as reported in the literature; a statement of the findings in the animals used in the investigation; the blood supply of the cochlea; summary and conclusions.

Dr. Lurie knows more about the finer anatomy of the internal ear than I do, and more than a good many of the rest of us, due to his work with Prof. Davis and the physiologists collaborating with him. I asked Dr. Lurie to assume the role of a doubting Thomas in reviewing my findings. He has played his part most faithfully, but always kindly. I was especially anxious not to overdraw my conclusions, and equally anxious not to make false observations; therefore, if I am wrong, he is wrong. In this case, therefore, two shoulders carry the burden.

THE METHOD OF EXAMINATION.

The X-ray was used to determine pregnancy as well as the imminence of delivery. Most of the feti were obtained by abdominal section at the middle of pregnancy or near term. When the X-ray showed that one fetal head was at the brim of the pelvis, the mother was sacrificed.

The first pigs were given quinine by injection into the muscles of the abdominal wall. This produced such cruel sloughs that mouth feeding was substituted, at first by dropper, then by quinine in capsule. This method, which was suggested by Dr. Wherry, has proven most satisfactory.

The gestation time of a guinea pig is about 72 days. In order not to have the delivery get ahead of us and occur on a Saturday or holiday, or at night, and ruin the specimens, round the fourth or fifth week, when the X-ray showed that one fetal head was well engaged in the brim of the pelvis, the animal was chloroformed and the feti removed by section.

In the beginning, when the quinine was given subcutaneously, a number of pigs aborted. This has not been so frequent with mouth feeding. It has not happened when the animal was overwhelmed with doses of quinine every half hour for four or five hours, until it was sick unto death.

There is no stated group of symptoms in the animals overwhelmed by half-hour doses until they become toxic. They show weaknesses in their hind legs, stagger aimlessly about, develop convulsions, and finally usually die in one.

Those of you who have done any of this work know that the preparation of the specimens is long and often surrounded with disappointment. As the conspicuous action of quinine on the adult and fetal internal ear is hemorrhage, I did not have the preserving fluid injected by way of the common

carotid artery, but relied on killing the mother just before delivery, removing the feti by section, opening the bulla in order to bring the preserving fluid in contact with the cochlea and getting the whole specimen into the preserving solution with the utmost speed. In spite of these precautions, post-mortem degeneration was always a bugbear.

Fortunately, I was not studying the organ of Corti particularly, or looking for nerve degeneration, but was investigating only blood vessel changes and hemorrhage.

FINDINGS REPORTED IN THE LITERATURE.

Blood in the cochlea is a very common occurrence. It varies from what I believe is a physiological amount; that is, a few corpuscles or a thin line of corpuscles, one or two deep at the bottom of the basal whorl, to an amount of blood which can be classed as a hemorrhage. Investigators, working on the inner ear, generally dismiss a small amount of blood as an artefact, saying that it reaches the cochlea from the cranial cavity by way of the cochlea aqueduct. Other observers feel that the hemorrhages are similar to those in the human baby at birth and are due to asphyxia accompanying delivery, while others maintain that asphyxia is the cause, but think it is produced by the lethal dose of chloroform used to kill the animal.

It has been proven on adult animals that the ingestion of certain drugs, notably quinine and salicylic acid, is associated with hemorrhages in the cochlea. The investigators who have reported these findings have generally held that the hemorrhages are caused by the convulsions which the toxic action of the drugs produce; furthermore, after the giving of quinine, changes in the ganglion cells and in the organ of Corti have been found in the adult pig. Dr. Lurie has repeated the quinine experiments on the adult pig and found all the changes just mentioned. Recently Covell reported changes in the mitochondria of the ganglion cells of the auditory nerve of a pig whose mother had been given quinine.

Quinine has been found in mother's milk and in the placenta. This is as one would expect. One would expect, also, similar effects of quinine on mother and fetus.

SUMMARY OF MATERIAL.

Eleven adults, 23 feti: Mother given quinine.

Three adults, seven feti: Mother given salicylate of soda.

One adult, one fetus: Mother given mapharsen.

One young adult: Experimental fracture of skull; no quinine.

One young adult: Strangled; no quinine.

Six adults: No quinine.

Total feti, 31; total adults, 23. Total animals, 54.

Fifty-four animals in all were put through. In at least half of these the posterior part of the medulla and the cerebellum were removed and sectioned with the temporal bones. Both temporal bones were mounted on one slide. The sections averaged 14-16 microns. Forty to 50 sections were cut from each temporal bone and were mounted and studied in series.

DOSAGE.

The extremes of doses of quinine given were 6 cc. in two days and 92 gr. in 120 days. The average doses for the rest of the animals were around 20 gr.

The following four pigs show the findings in the minimum and maximum doses:

No. 45: Nine days old; 6 cc., two days. Findings: Hemorrhage about the VIIIth nerve. Hemorrhage into bone marrow.

No. 81: Adult female; 61 gr., four and one-half months. Findings: Hemorrhage into the scala tympani, basal whorl.

No. 242: Fetus near term. Mother given 75 gr. quinine in 115 days. Findings: Slight hemorrhage into the scala tympani; no dilated vessels.

No. 78: Adult female (aborted twice; feti too young for study); 92 gr. quinine, 120 days. Findings: Slight hemorrhage in the scala tympani.

No. 46. Fetus. Mother was given eight doses of quinine in nine days, 3 cc. a dose, making in all 24 cc. This fetus showed most extensive hemorrhages. Practically the whole cochlea was full of blood (see Figure 13).

QUININE CASES, MATERIAL AND FINDINGS.

Pig No. 27: Number of doses, six; period of time, 6 days; average dose, 1 cc.; total amount given, 6 cc. Adult: Hemorrhages about facial nerve.

Pig No. 42-199: Number of doses, four; period of time, four days; average dose, 5 cc.; total amount given, 20 cc. Young adult, tested by Dr. Davis; normal hearing. Mesenchymal tissue still present in middle ear. Findings: Hemorrhage under endosteum of bulla; hemorrhage at base of bulla under endosteum; no hemorrhage into cochlea; pus in middle ear. Mother not through.

Pig No. 45-193: Number of doses, two; period of time, two days; average dose, 3 cc.; total amount given, 6 cc. Nine days old: Hemorrhage about VIIIth nerve and hemorrhage into bone marrow.

Pig No. 46: Number of doses, eight; period of time, nine days; average dose, 3 cc.; total amount given, 24 cc. Mother not through. Three of five feti run through. All show hemorrhage. One fetus showed most extensive hemorrhage of all specimens; that is, hemorrhage in both the scala tympani and scala vestibuli. Hemorrhage up to the helicotrema. Hemorrhage under the endosteum of the bulla.

Pig No. 49: Number of doses, one; average dose, 2 cc.; total amount given, 2 cc. Mother not through; two feti—204-211. Fetus No. 1: Found dead at one month; hemorrhage into scala tympani; hemorrhage about auditory nerve. Fetus No. 2: Hemorrhage into bone marrow; slight hemorrhage in scala tympani; large hemorrhage about basal whorl of cochlea.

Pig No. 51: (No quinine.) Adult; no hemorrhage.

Pig No. 52-230: Number of doses, eight and 11; average dose, 5 cc. and 1 gr. P.O.; total amount given, 40 cc. and 11 gr.

Adult. Findings: Moderate hemorrhage into scala tympani. Hemorrhage about facial nerve.

Pig No. 53: (No quinine.) Adult; normal. No hemorrhage.

Pig No. 55-216: (No quinine.) Adult: No quinine but large hemorrhage in scala tympani, basal whorl. Slight hemorrhage into vestibule, left ear. Mother was very sick for several days. Eight days previously, animal gave birth to litter of three pigs. (A double number means that the pig was in Dr. Lurie's series also.)

Pig No. 60: (No quinine.) Mother had no medication. Fetus: Pig did poorly and died six days after birth. Cause of death not known. Pig might have been overlain by mother. Large hemorrhage, scala tympani, basal whorl. Marked hemorrhage into the vestibule. Mother died two or three days later of an infection prevalent in the laboratory at the time.

Pig No. 66: Number of doses, 25; period of time, 32 days; average dose, 1 gr.; total amount given, 25 gr. Female, non-pregnant adult. Hemorrhage of the scala tympani.

Pig No. 70: Number of doses, 18; period of time, 23 days; average dose, 1 gr.; total amount given, 18 gr. Mother not through. Fetus A: Hemorrhage under endosteum of cochlea; hemorrhage in scala tympani; hemorrhage about basilar artery. Fetus B: Large hemorrhage in the scala tympani and about basilar artery; hemorrhage into bone marrow.

Pig No. 71: Number of doses, 23; period of time, 29 days; average dose, 1 gr.; total amount given, 23 gr. Mother not through. Fetus A: Hemorrhage under endosteum of bulla; hemorrhage into bone marrow; small hemorrhage in scala tympani. Fetus B: Hemorrhage under endosteum of bulla; hemorrhage into bone marrow; slight hemorrhage through scala tympani.

Pig No. 72: Number of doses, 92; period of time, 120 days; average dose, 1 gr.; total amount given, 92 gr. Pregnant twice; aborted twice. Feti too young for study. Slight hemorrhage into scala tympani, showing break in vessels.

Pig No. 73: Number of doses, 25; period of time, 42 days; average dose, 1 gr.; total amount given, 25 gr. Female, not pregnant. Tested by Dr. Davis. Large hemorrhage into scala tympani, basal whorl. Vessels show break.

Pig No. 74: (No quinine.) Adult female; no medication. One slight hemorrhage in scala tympani, vessels show break.

Pig No. 75: Number of doses, three; period of time, five days; average dose, 1 gr.; total amount given, 3 gr. Mother overwhelmed by 12 doses in two hours. Slight hemorrhage into bone marrow. Hemorrhage into scala tympani, showing break. Three babes delivered by section. One fetus spoiled. Fetus A: No findings. Fetus B: Marked hemorrhage in the bone marrow; hemorrhage about bulla artery; marked hemorrhage beneath endosteum of bulla cavity.

Pig No. 76: Number of doses, 10; period of time, three and one-half hours; average dose, 2 gr.; total amount given, 20 gr. Overwhelmed; mother not through. Fetus A: Slight hemorrhage of scala tympani, vessels show break. Fetus B: Hemorrhage into bone marrow; hemorrhage about basilar artery; hemorrhage under endosteum of bulla cavity; marked engorgement of vessels over endosteum of bone.

Pig No. 78: Number of doses, 12; period of time, 26 days; average dose, 1 gr.; total amount given, 12 gr. Mother not through; delivered one babe. Fetus: Hemorrhage into bone marrow; hemorrhage under endosteum of bulla and under endosteum of bulla cavity.

Pig No. 79: Number of doses, 22; period of time, 43 days; average dose, 1 gr.; total amount given, 22 gr. Female; not pregnant. Hemorrhage into scala tympani; hemorrhage about auditory nerve.

Pig No. 81: Number of doses, 61; period of time, four and one-half months; average dose, 1 gr.; total amount given, 61 gr. Female; not pregnant. Fell and found dead next morning. Hemorrhage into scala tympani, basal whorl.

Pig No. 82: Mother still alive. Had two doses of quinine four days before delivery. Fetus A: Hemorrhage into scala tympani, basal whorl; hemorrhage at apex into scala tympani and scala vestibuli; marked hemorrhage into bone marrow; hemorrhage about auditory nerve and modiolus.

Pig No. 85: Number of doses, 32; period of time, 42 days (8 gr. in two and one-half hours before death); average dose, 1 gr.; total amount given, 32 gr. Overwhelmed; four feti. Fetus A: Hemorrhage into the medulla; hemorrhage into the wall of the cochlea; hemorrhage into the mesenchymal tissue; slight hemorrhage into vestibule. Fetus B: Hemorrhage about VIIIth nerve; hemorrhage under endosteum of cochlea at apex; large hemorrhage into mesenchymal tissue at apex of cochlea; blood in the aqueduct of Sylvius; hemorrhage in the medulla. Fetus C: Hemorrhage under the pia; hemorrhage into bone marrow. Fetus D: Hemorrhage into scala tympani; hemorrhage into the mesenchymal tissue, about medulla; engorged bone marrow; slight hemorrhage into scala vestibuli; small hemorrhage into medulla.

Pig No. 242: Number of doses, 75; period of time, 115 days; average dose, 1 gr.; total amount given, 75 gr. Mother not through. One fetus. Slight hemorrhage in scala tympani. Hemorrhage in the middle ear.

Pig No. 227: Normal adult. No quinine. No hemorrhage. No congestion of bone marrow.

Mapharsen: Number of doses, 18; period of time, nine hours; average dose, 1 mg.; total amount given, 18 mg. Mother overwhelmed with mapharsen; no findings. Fetus: Marked congestion and hemorrhage of bone marrow. Pronounced hemorrhage into scala vestibula and into the vestibule. Subpial hemorrhages; small hemorrhage into the medulla. Much hemorrhage into the mesenchymal tissue lining the bulla cavity. Hemorrhage into semicircular canals.

Pig No. 240R: Supposedly normal. Hemorrhage into scala tympani and under endosteum of external auditory meatus.

Fracture specimen: Young pig, two months old, killed by two blows in side of head. Large hemorrhage, scala tympani, subpial hemorrhage about the medulla. Hemorrhage in modiolus about VIIIth nerve. Hemorrhage, scala tympani, upper whorl and lower whorl.

Pig No. 208: Waltzing guinea pig. Adult. Pig found dead a day after birth. Hemorrhage under endosteum of bulla cavity, near cochlea.

ANIMALS TESTED BY DR. DAVIS.

Pig No. 31-197: Normal response to hearing. No hemorrhage in cochlea. Pus and blood in middle ear. Hemorrhage under the endosteum of bulla cavity. 54 cc. quinine = 12 doses.

Pig No. 199-42: Number of doses, five; average dose, 5 cc.; total amount given, 20 cc. quinine. Young adult, tested by Dr. Davis. No hemorrhage into the cochlea. Pus in middle ear. Hemorrhage at base of bulla, under endosteum.

Pig No. 198: Number of doses, 17; total amount given, 20 cc. quinine. Adult, tested by Dr. Davis. Normal hearing. Hemorrhage about facial nerve. Hemorrhage into the scala tympani, round window. Pus in middle ear.

Pig Nos. 197-198-199: All tested and found to have normal hearing in spite of the injections with quinine. One had hemorrhage in the scala tympani of the round window and

one had hemorrhage about the facial nerve. All had pus in the middle ear, perhaps due to the testing of the hearing.

Pig No. S91: Number of doses, seven; period of time, three hours; average dose, 5 gr.; total amount given, 35 gr. sodium salicylate. Mother not through.

Pig No. S93: Number of doses, five; period of time, five days; average dose, 5 gr.; total amount given, 35 gr. sodium salicylate. Mother overwhelmed. Slight hemorrhage in scala tympani, round window. Hemorrhage about facial nerve. Fetus A: Hemorrhage into mesenchymal tissue at the attachment of membrane of round window; hemorrhage into mesenchymal tissue about malleus; hemorrhage into mesenchymal tissue about stapes; hemorrhage about border of stapes. Fetus B: Slight hemorrhage into scala tympani; hemorrhage into semicircular canal; marked hemorrhage into the bony capsule of the bulla at apex. Fetus C: Hemorrhage into scala tympani; hemorrhage about crus of stapes; hemorrhage into the membrane of round window; hemorrhage in the aqueduct of Sylvius; hemorrhage into the internal attachment of the round window; hemorrhage under the endosteum of cochlea. Fetus D: Hemorrhage in the scala tympani at round window; hemorrhage under pia of lateral side of cerebellum; hemorrhage in the mesenchymal tissue about the malleus and incus.

Pig No. S94: Number of doses, nine; period of time, six hours; average dose, 2.8 gr.; total amount given, 25.2 gr. sodium salicylate. Mother. Hemorrhage into base of round window. Slight hemorrhage into the scala tympani. Fetus A: Hemorrhage into bone marrow; hemorrhage in the medulla; hemorrhage under pia; hemorrhage under endosteum of bulla; hemorrhage throughout the mesenchymal tissue about the foramen magna; much mesenchymal tissue about round window and the ossicles. Fetus B: Hemorrhage under pia about cerebellum; slight hemorrhage about the VIIIth nerve in the modiolus; hemorrhage in the mesenchymal tissue about malleus and incus; hemorrhage about stapes; hemorrhage into the drum membrane. Fetus C: Hemorrhage into the mesenchymal tissue about stapes; hemorrhage under the endosteum about cochlea.

Pig No. S1000: Number of doses, four; period of time, four hours; average dose, 5 gr.; total amount given, 20 gr. sodium salicylate. Young male. Overwhelmed. Slight hemorrhage into connective tissue about medulla.

THE BLOOD SUPPLY OF THE COCHLEA.

The blood supply of the cochlea in man as well as in the guinea pig is especially rich. In man there are said to be some 30 vessels.

In the guinea pig a root artery enters the cochlea at the base of the modiolus and at once divides into two lateral

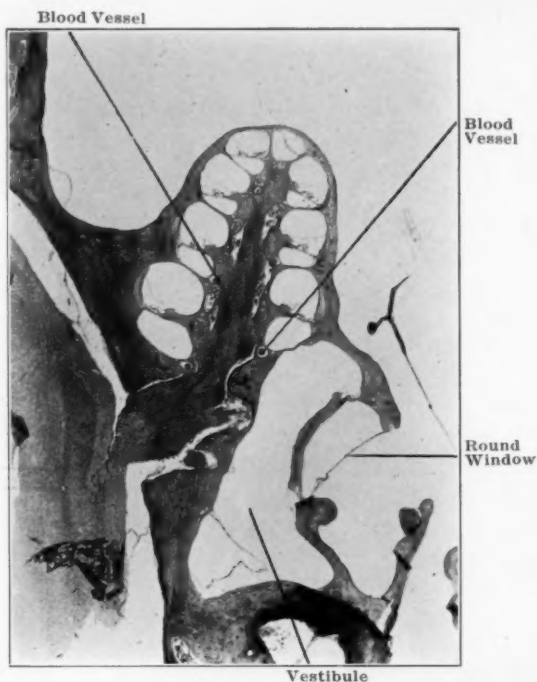


Figure 1.—This illustration is used to show normal anatomy.

branches, one for each side. These two lateral branches run upward and near the base of the spiral lamina, where it divides the various turns of the cochlea, a branch is given off to the spiral lamina of each division. As the vessels run in the spiral lamina and spray around the component divisions of the cochlea, they gradually come to the surface of the bone and lie under the endothelium lining the divisions of the cochlea. In places, the vessels, the walls of which are

only one cell thick, are practically naked in the endolymph. This makes the secretion of the endolymph easy and rupture of the vessels also easy. A full realization of this point is necessary to the understanding of the conclusions drawn in this paper.

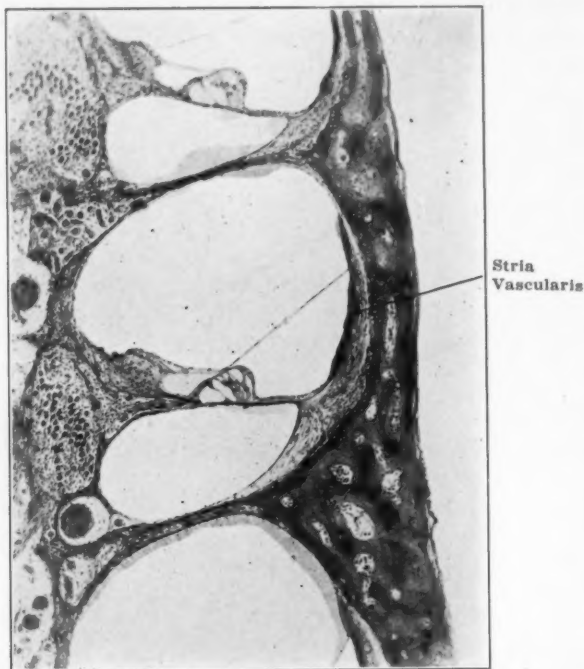


Figure 2.—Normal adult. The illustration shows the stria vascularis and two of the main arteries of the cochlea on the inner edge of the modiolus.

The course of the vessels to the surface of the bone and their eventual nakedness is best seen in the basal whorl of the guinea pig's cochlea. The same arrangement, however, holds throughout the rest of the cochlea. The vessels are best recognized when they are congested, as they are after the administration of quinine or some such toxic agent.

The more I have studied these engorged and naked vessels the more I have felt that it takes but a little increase of pres-

sure within them to make them leak; that is, to permit the escape of blood and serum, or even to break.

The blood vessels of the cochlea compartments are reduced to their lowest terms. In other words, they are simply capillaries one layer of endothelium thick. This simplicity of structure enables them to carry out their physiological func-

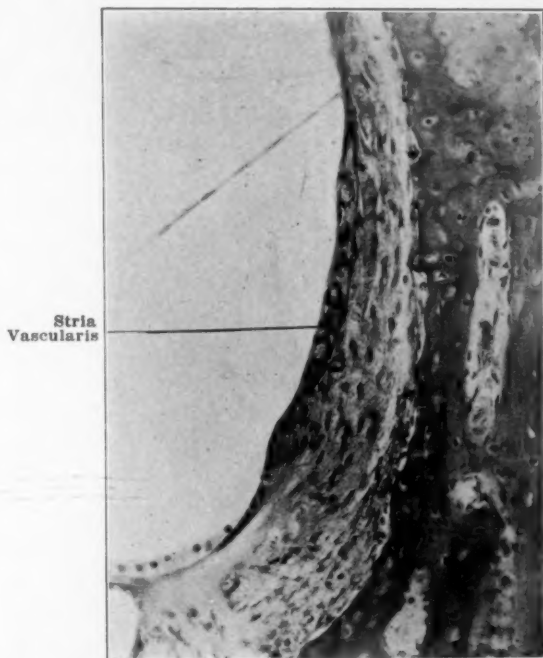


Figure 3.—Pig No. 82. A15. Foetus. x350. To show the stria vascularis. (Quinine pig.)

tion of supplying lymph. Also it makes them very friable when subjected to increased pressure.

The blood vessels of the mesenchymal tissue are of the same frail character. The loose tissue about them gives them little support.

The lining membrane of the bulla cavity of the guinea pig is not mucous membrane as one might expect, but a single

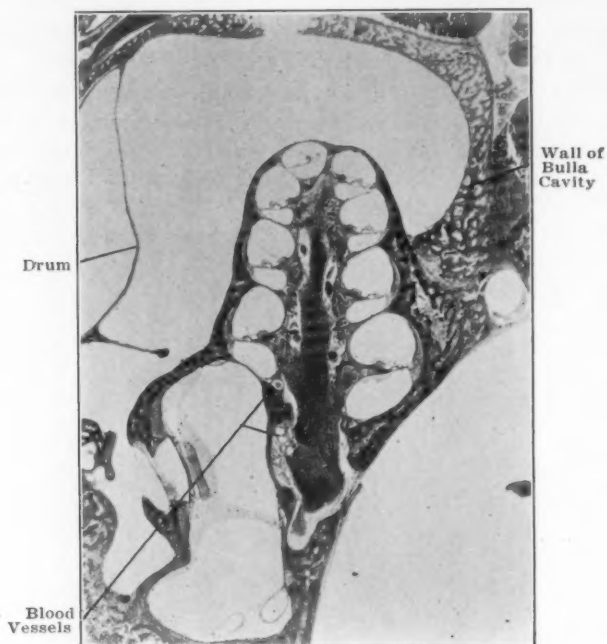


Figure 4.—Pig No. 82. Slide A. Section 16. x19. The illustration shows the blood supply of the cochlea. (Quinine pig.)

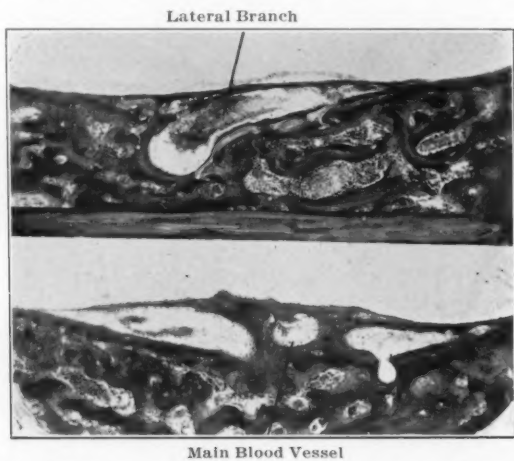
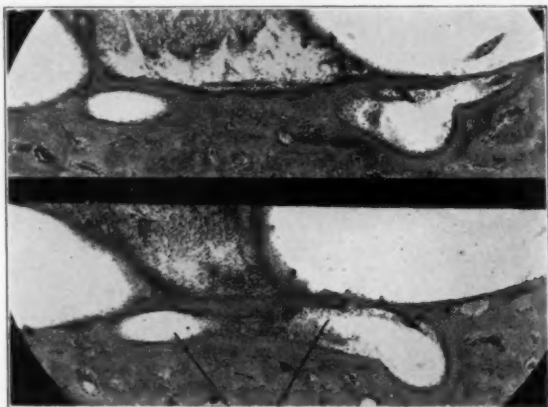


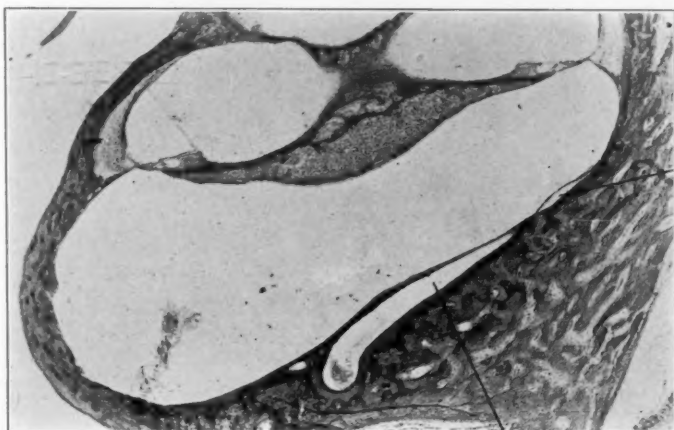
Figure 5.—Pig No. 76. Slide A. Section 8. 55x. The illustration shows the blood supply of the cochlea. (Quinine pig.)

layer of endothelial cells. The covering of the cochlea is the same, and the compartments of the cochlea have a similar



Artery

Figure 6.—The illustration shows the root artery of cochlea dividing at the base of the modiolus. Mother overwhelmed by 20 gr. of quinine in three and one-half hours. Temporal bone of foetus not through. Foetus No. 76. Slide A. Section 8. x55.



Blood Vessel with Bone Covering

Figure 7.—The figure shows the basal artery of the cochlea in the lower whorl. Notice how it loses its bony covering to the reader's right. (Quinine pig.)

primitive lining under which the blood vessels run. About the opening of the Eustachian tube mucous membrane of the

ordinary type appears. When the vessels of the cochlea are engorged from the effect of quinine, one can readily find places where the vessels have lost their covering of endothelium.

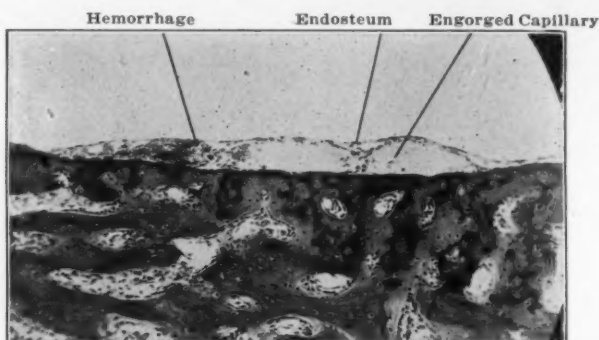


Figure 8.—Pig No. S93. A6. x120. Foetus A: The illustration shows two dilated vessels and one ruptured vessel in the scala tympani, basal whorl. Notice the thinness of the endosteum of the cochlea as it covers the vessel. (See Figures No. 26-29.) (Sodium Salicylate pig.)

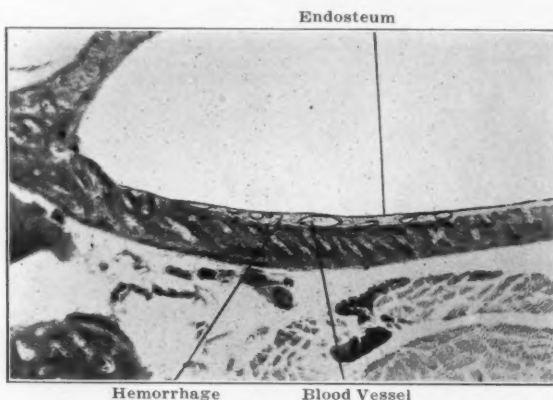


Figure 9.—Pig No. 71. Slide B. Section 9. 35x. Female, pregnant; 23 doses of quinine in one month; delivered three babies; all chloroformed. Foetus B9: The illustration shows the capillaries of the scala tympani in the basal whorl. They are covered only by endosteum.

The vessels of the cochlea are all terminal branches, like the vessels of the heart and the retina. The last two are notorious for calamitous accidents. It looks a bit as if the vessels of the cochlea may have the same unpleasant habit. One

thinks at once of the so-called Ménière's syndrome. Still speaking of the vessels of the cochlea, one wonders what happens when a root artery is narrowed by arteriosclerosis. In such a case some part of the cochlea must surely suffer.

SOURCES OF ERROR.

Investigators who have done much work on the internal ear of animals state that it is not uncommon to find hemorrhages into the cochlea. The explanation has always been

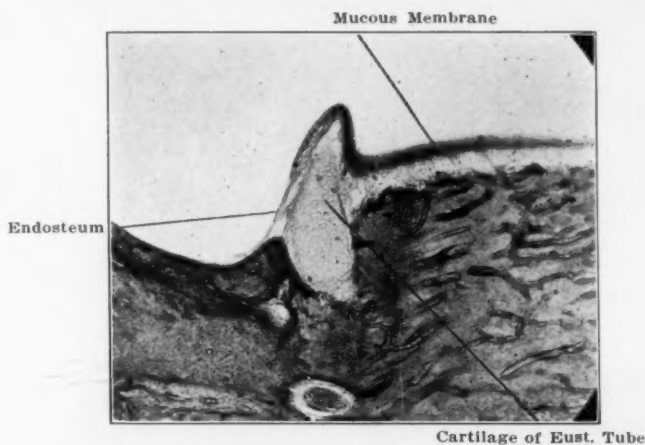
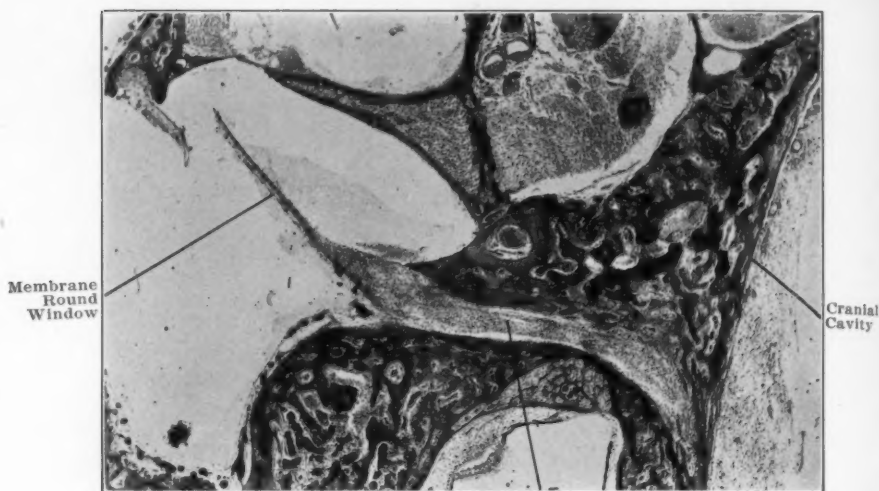


Figure 10.—Plg No. 163. R16. 55x. To show the endosteum lining, the bulla cavity and the change into mucous membrane at the Eustachian tube.

that the blood was set free from the meningeal vessels at the removal of the specimen and gained access to the cochlea by the cochlea duct. In the fetus the duct is practically closed by a network of mesenchymal tissue. In the adult animal the amount of this tissue is less, but still the network is marked. When there is frank hemorrhage in the cochlea there is always blood in the duct near the round window, and it may infiltrate, diminishing in amount almost to the far end of the duct. My feeling is that hemorrhage in the cochlea is rarely if ever an artefact of this character.

The internal auditory meatus is often found to be filled with blood. This comes at the removal of the specimen and



Aqueductus Cochlearis

Figure 11.—Fig No. 186. Slide 10. 40x. The illustration shows the aqueduct cochlearis. The membrane of the round window was broken in the preparation of the section.

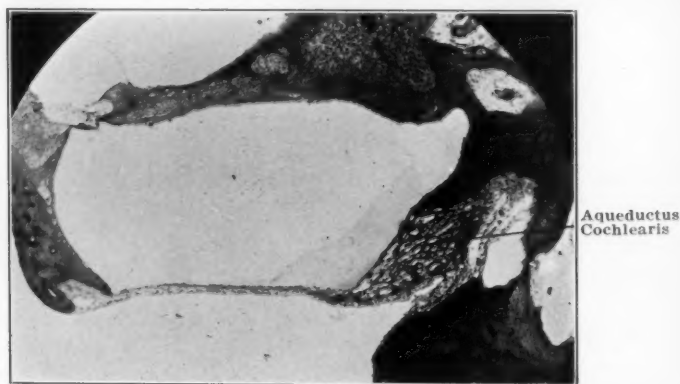


Figure 12.—Fig No. 212. 49. R8. 55x. Mother given one dose of 2 cc. of quinine. Mother's temporal bone not through. Findings: Foetus A—Hemorrhage into scala tympani; hemorrhage about auditory nerve. Foetus B—Hemorrhagic bone marrow; slight hemorrhage in scala tympani; large hemorrhage about basal whorl of cochlea. The illustration shows the meshwork of fibrous tissue in the cochlea aqueduct. (See Plate No. 28.)

is an artefact. Only hemorrhage in the modiolus itself and about the VIIIth nerve can be considered as hemorrhage into the nerve. Again hemorrhage under the pia has to be looked at with caution. The dura and the meninges have to be cut in removing the posterior part of the cerebellum with the tem-

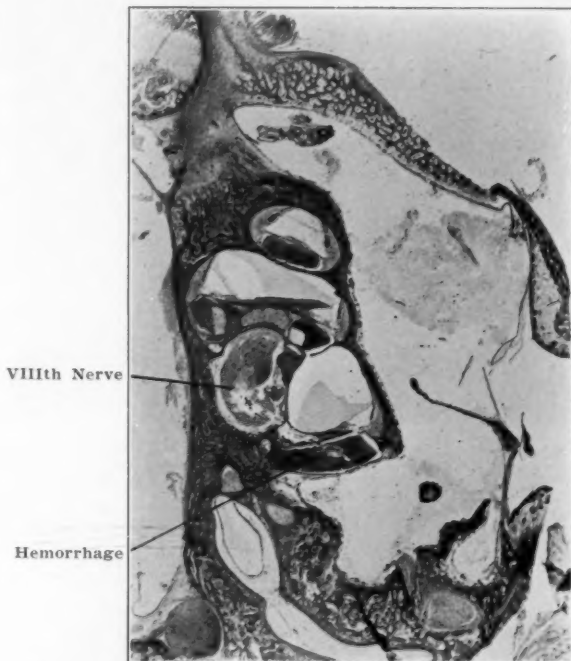


Figure 13.—Pig No. 46 and 186. Foetus. Mother given 24 cc. of quinine in eight doses of 3 cc. over a period of nine days; mother not through. Three of five foeti run through and all show large hemorrhage in scala tympani and in scala vestibuli. The wall of the bulla cavity as shown in this specimen is often the site of hemorrhage, especially at the base of the cochlea; the blood vessels in the mesenchymal tissue covering the cochlea are injected; this is almost constant in the foeti where the mother has been given quinine or salicylic acid.

poral bones, as was done in my specimens. Therefore, only in places where the pia was intact and the hemorrhage was enclosed by it; that is, was within it, was the hemorrhage considered significant. There is usually hemorrhage of a certain amount outside the pia, especially at the base of the brain around the cerebellum.

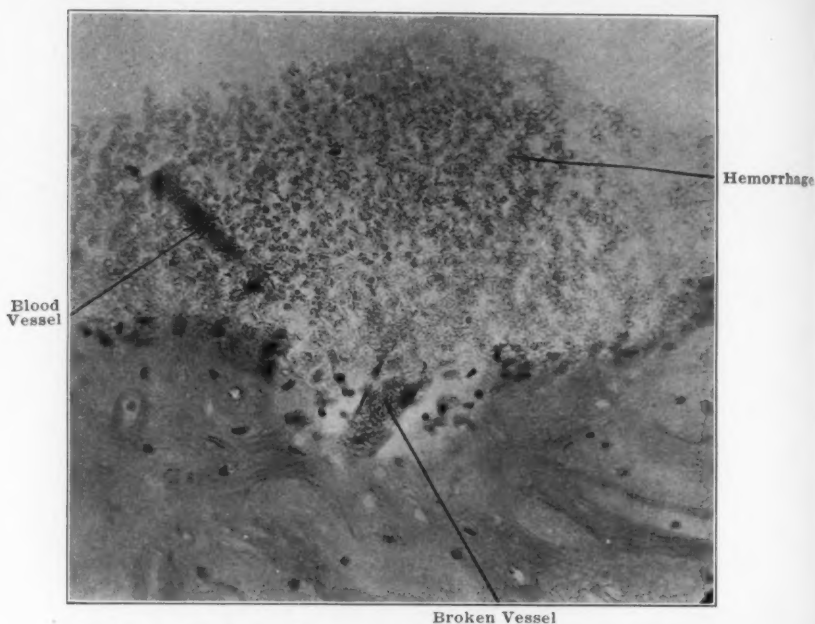


Figure 14.—Pig No. 73. Left ear. Section 4. x250. Adult—Not pregnant. Given 25 gr. of quinine in 25 days, 1 gr. doses. Tested by Dr. Davis: Report—Slight impairment of hearing. Findings: Hemorrhage into medulla; large hemorrhage into scala tympani, basal whorl.

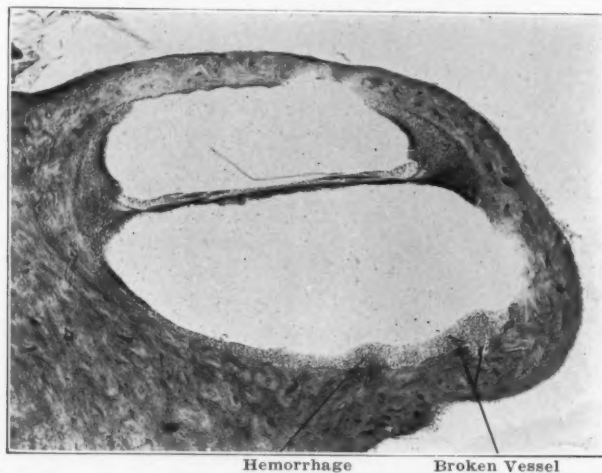


Figure 15.—Pig No. 73. Left ear. Slide No. 4. x40. Adult, not pregnant. Given 25 gr. of quinine in 1 gr. doses in 42 days. Findings: Large hemorrhage into scala tympani, basal whorl; one vessel shows break. The illustration shows one broken vessel with hemorrhage overlying it.

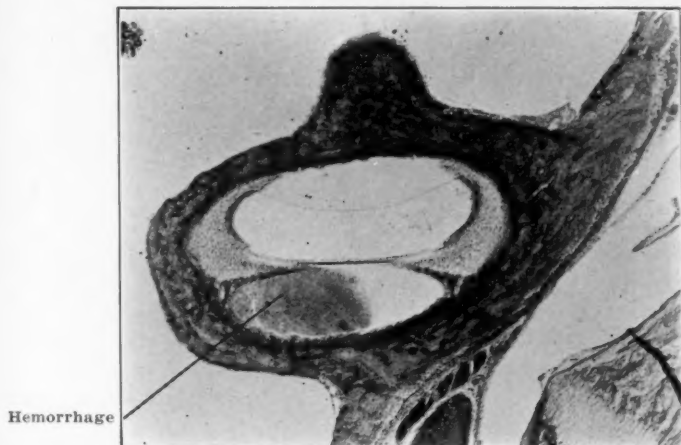


Figure 16.—Pig No. 70. Foetus B. Mother given 18 gr. of quinine in 23 days in 1 gr. doses. Mother's temporal bone not through. Findings: Foetus A—Hemorrhage under endosteum of cochlea; in scala tympani, and about basilar artery. Foetus B—Large hemorrhage in scala tympani and about basilar artery; congested bone marrow. The illustration, foetus B, shows a large hemorrhage into the scala tympani, basal whorl; hemorrhage under the endosteum of the cochlea as found in these specimens is a frequent finding.

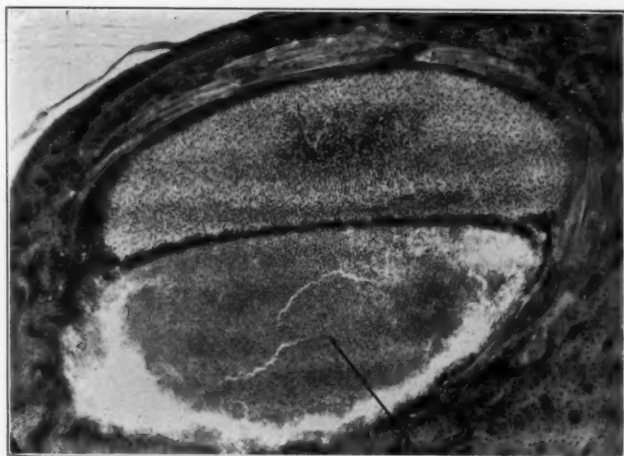
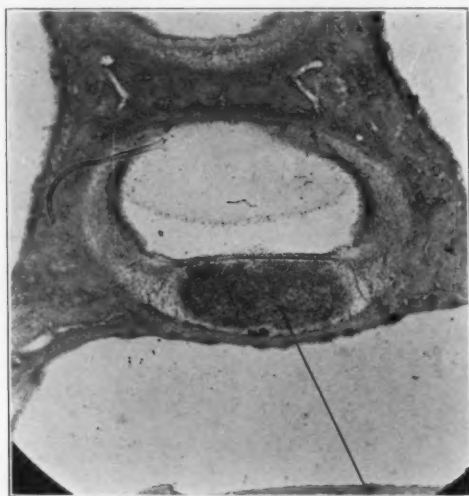


Figure 17.—Pig No. 70. Foetus B. Mother given 18 1 gr. doses of quinine in 23 days. Findings: Large hemorrhage in scala tympani and under pia about basilar artery; hemorrhage into bone marrow.

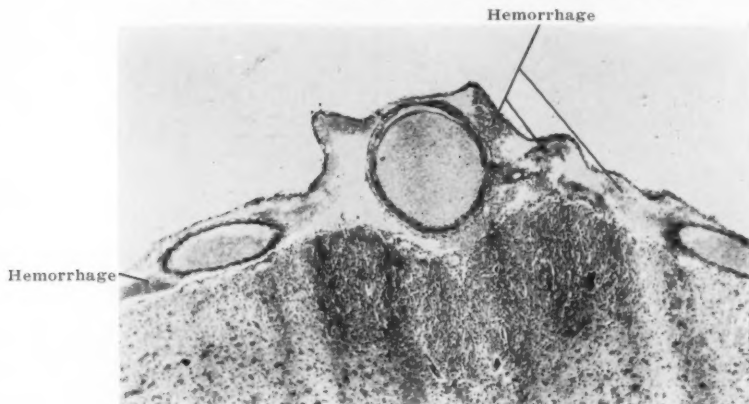
THE RESULTS OF THE QUININE SERIES.

The action of quinine in both the adult pig and the fetus is to produce intense congestion of the cerebral vessels and



Hemorrhage

Figure 18.—Guinea pig No. 253. Slide B. Section 2. x60.

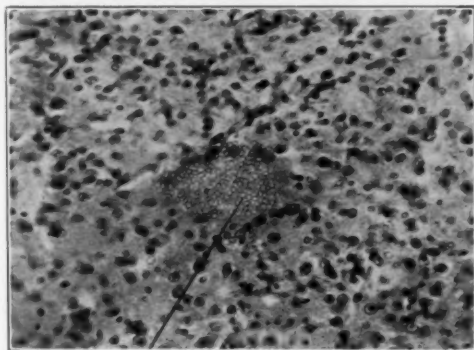


Hemorrhage

Hemorrhage

Figure 19.—Pig No. 70. A35. x70. Eighteen doses of quinine in three weeks; delivered two offspring, all chloroformed. Baby A35: Hemorrhage about the basilar artery.

the vessels of the cochlea associated with hemorrhage. Hemorrhage is found in every location. It is most striking in the cochlea, but is found in the modiolus about the VIIIth nerve,



Hemorrhage in the Medulla

Figure 20.—Pig No. 85. Foetus D12. x250. Mother was given 32 gr. of quinine in 1 gr. doses in 42 days; then 8 gr. in two and one-half hours before death. Four (4) foeti. Findings Foetus A—Hemorrhage in the medulla; the wall of the cochlea; the mesenchymal tissue; slight hemorrhage into vestibule. Foetus B—Hemorrhage about VIIIth nerve; under endosteum of cochlea at apex; large hemorrhage into mesenchymal tissue at apex of cochlea; blood in aqueduct of Sylvius and hemorrhage into medulla. Foetus C—Hemorrhage under pia; hemorrhage into bone marrow. Foetus D—Hemorrhage in scala tympani; into mesenchymal tissue about medulla; hemorrhagic bone marrow; slight hemorrhage into scala vestibuli; small hemorrhage into medulla.



Hemorrhage

Figure 21.—Pig No. 85. Pregnant; 32 doses of quinine in six weeks, then 8 gr. in two and one-half hours; total dosage, 40 gr.; died following convulsion; four foeti removed by section. Foetus 85A—170x. Finding: Hemorrhage into the VIIIth nerve.

384 MOSHER: ANIMAL EXPERIMENTATION WITH QUININE.

about the facial nerve, round the basilar artery, under the pia, and in the medulla. Hemorrhage in the semicircular canals was rare in my specimens, but was marked in the mapharsen fetus.

In the quinine foeti especially, the vessels of the stria vascularis are often much engorged. So far I have found no break in them. These vessels are relatively thick-

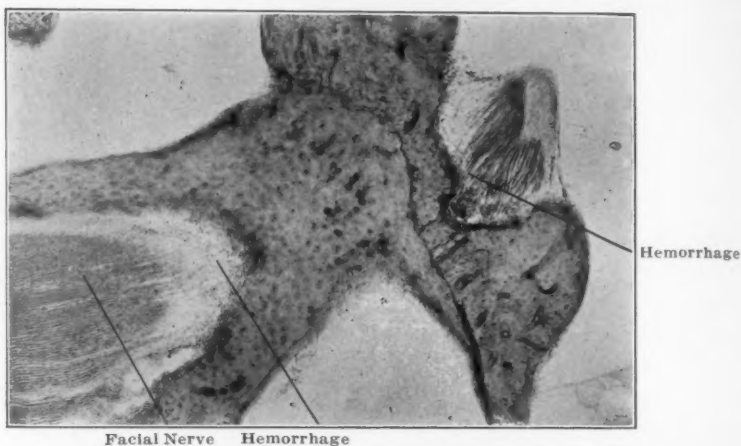


Figure 22.—Pig No. 893. Section 15. x85. Mother given 35 gr. of sodium salicylate in five days. Four (4) foeti. Findings: Mother—Hemorrhage in scala tympani at round window; hemorrhage about facial nerve. Foetus A: Hemorrhage in mesenchymal tissue about round window and in membrane of the round window; hemorrhage in mesenchymal tissue about ossicles; hemorrhage (small) in scala tympani. Foetus B: Hemorrhage in bone marrow; slight hemorrhage in scala tympani; basal whorl; slight hemorrhage in one semicircular canal. Foetus C: No hemorrhage in semicircular canal; other findings the same as in Foetus B. Foetus D: Hemorrhage in scala vestibuli; hemorrhage into mesenchymal tissue about malleus and incus.

walled compared with the other vessels of the cochlea compartments.

THE RESULTS OF THE SODIUM SALICYLATE SERIES.

Three mature pigs and one young adult were given sodium salicylate. The young pig was overwhelmed. He showed slight hemorrhage in the connective tissue about the medulla. The specimen of one adult has not come through. In the remaining two specimens of the four, both mother and feti showed hemorrhages. These were

especially marked in the mesenchymal tissue of the middle ear.

Between 20 and 35 gr. of salicylate were given before the animals became toxic. The young pig which was overwhelmed

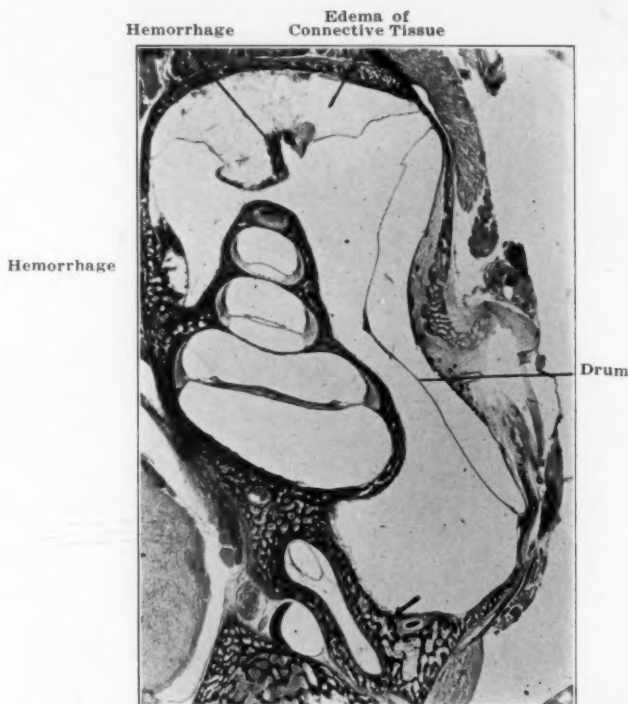


Figure 23.—Pig No. 75. Foetus B. Mother overwhelmed by 12 doses of quinine in two hours. Three foeti delivered by section; one spoiled. Findings: Mother—Hemorrhage into scala tympani; one vessel shows break. Foetus A—No findings. Foetus B—Hemorrhagic bone marrow; hemorrhage about basilar artery; hemorrhage beneath endosteum of bulla cavity. On opening the bulla, blood was seen beneath the endosteum. The illustration shows edema of the connective tissue beneath the endosteum of the bulla cavity and hemorrhage.

was given 5 gr. every half hour for four doses. After giving salicylate the toxic manifestations are similar to those following the giving of quinine. It was not until more than 20 gr. of the salicylate was given that the animals became deaf to hand-clapping. It is my impression that taken as a

whole, sodium salicylate produces less congestion of the cochlea vessels than quinine causes.

THE MAPHARSEN EXPERIMENTS.

The mapharsen experiment was perhaps the most striking of all. An adult female pig was overwhelmed by 10 1 mg. doses in nine hours. There was one fetus which was removed by section. The placenta was found detached.

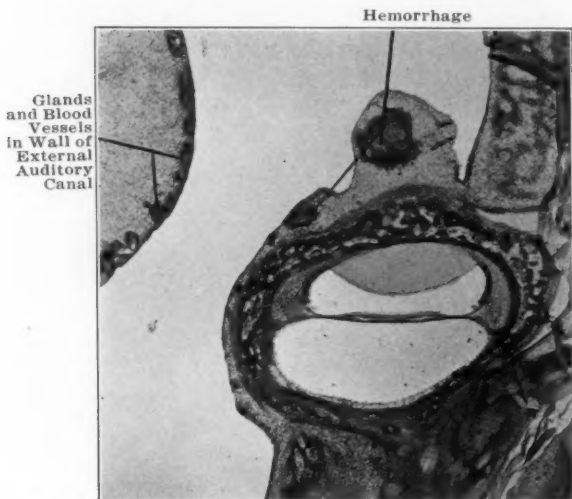


Figure 24.—Pig No. 85. Slide 37. Section 18. Mother given 32 doses of quinine in six weeks, then 8 gr. in two and one-half hours; total dosage, 40 gr.; died following convulsion; four babies removed by section. Fetus B—The illustration shows large hemorrhages into the mesenchymal tissue covering the cochlea.

The cochlea of the mother showed a few blood corpuscles in the basal whorl at the round window, and a small hemorrhage about the basilar artery. There was no dilatation of the blood vessels. The cochlea might easily pass for normal.

The feti, on the other hand, showed large hemorrhages in the scala vestibuli and into the vestibule. There was abundant hemorrhage in one of the semicircular canals. All vessels were greatly dilated. There were large hemorrhages in the bone marrow, and hemorrhages were present in the mesenchymal tissue lining the bulla cavity and about the ossicles.

There were subpial hemorrhages and a small hemorrhage into the medulla. There was a small hemorrhage into the scala tympani in the second whorl.

This fetus was the only one to show large hemorrhages into the scala vestibuli, the vestibule and the semicircular

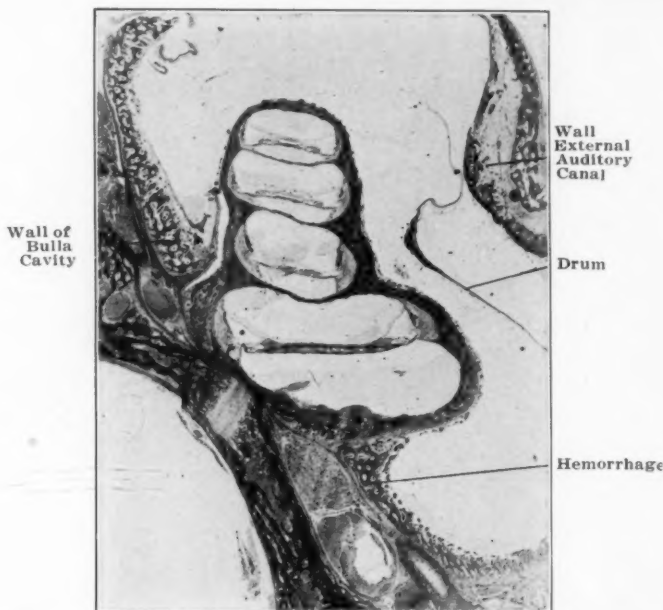


Figure 25.—Pig No. 46. Mother given 24 cc. of quinine in eight doses of 3 cc. over a period of nine days; aborted. Five (5) foeti numbered 184-5-6-7-8. Three (3) foeti examined; all three show marked hemorrhage into the cochlea.

Foetus No. 186, Section 3. x19. This illustration shows hemorrhage into the mesenchymal tissue covering the cochlea. The base of the cochlea to which the pointer heads is a favorite place for hemorrhage in the foetus. Hemorrhage is often found also under the endosteum of the whole of the bulla cavity.

canals. In all the other feti, that is, in the quinine and sodium salicylate feti where hemorrhage was present, it was in the scala tympani and generally in the basal whorl around the round window.

A second pig was overwhelmed with mapharsen. The sections of the temporal bones of mother and feti are not yet

through. One fetus was tested for arsenic and the test was positive.

THE FRACTURE EXPERIMENT.

Feeling that the cochlea vessels break easily owing to their nakedness and thinness, I wondered what a blow on the head

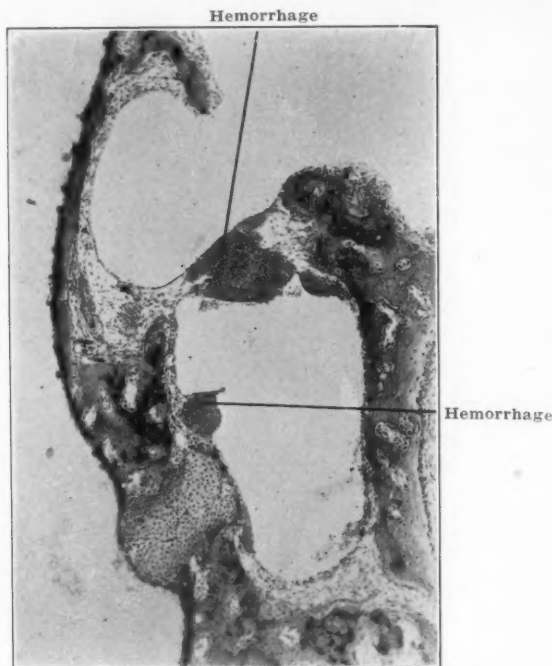


Figure 26. Pig No. S93. Foetus A-26. x100. Mother overwhelmed with 35 gr. of sodium salicylate in three hours; average dose, 5 gr. Four (4) foeti. Temporal bone of mother shows slight hemorrhage about facial nerve; slight hemorrhage into scala tympani. Summary of findings: Foeti A and B: No hemorrhage into cochlea; slight hemorrhage into bone marrow; hemorrhage into mesenchymal tissue about ossicles; hemorrhage into medulla; much mesenchymal tissue about round window and ossicles. The illustration is from Foetus A. It shows hemorrhage into the mesenchymal tissue about the stapes.

sufficient to kill the animal would do. Accordingly a young pig was killed by two smart blows on the side of the head. There was no fracture of the skull.

Section 2 showed a large hemorrhage in the scala tympani at the base of the cochlea; section 6 showed subpial hemorrhage at the side of the medulla; section 8 showed hemor-



Hemorrhage

Figure 27.—Pig No. S93. Foetus A. Section 19. x80. The illustration shows hemorrhage into the mesenchymal tissue surrounding the ossicles. (Sodium Salicylate pig.)

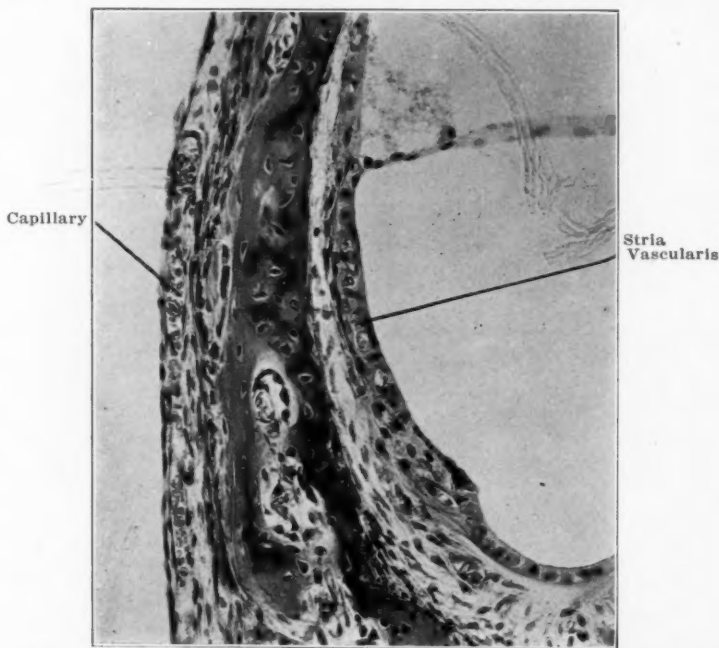


Figure 28.—Pig No. S93. D15. x250. The illustration shows a portion of the wall of the cochlea. On the outer wall under the endosteum a small capillary runs. It is much engorged. (Sodium Salicylate pig.)

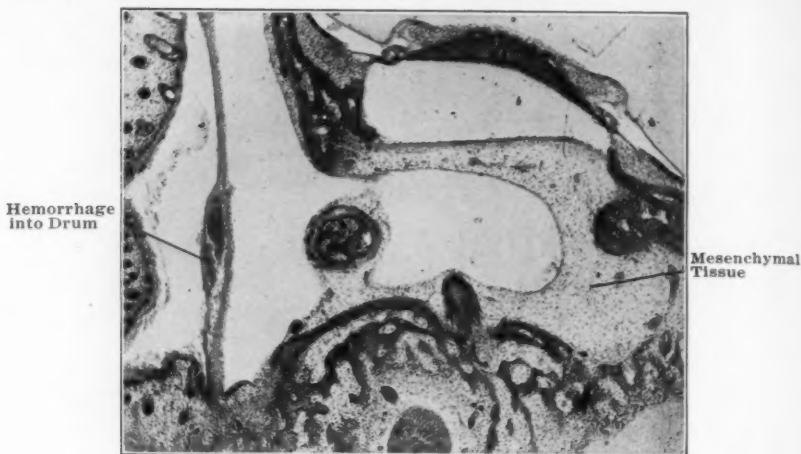
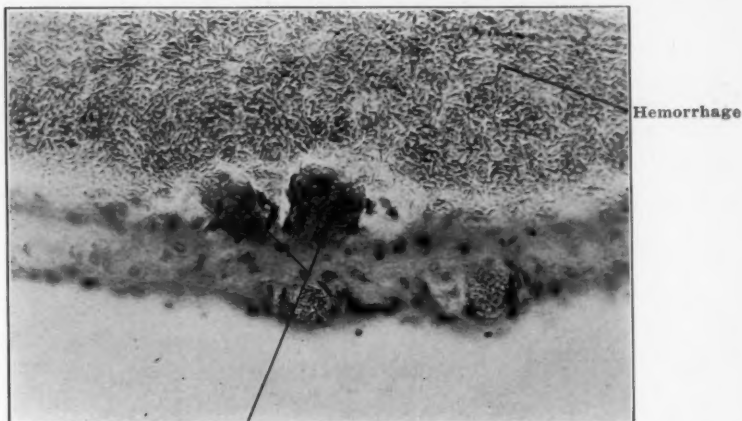


Figure 29.—Pig No. S94. Foetus B. Section 11. x49. The illustration shows much mesenchymal tissue about the membrane of the round window and hemorrhage into the drum. (Sodium Salicylate pig.)



Figure 30.—Pig No. 253. Mother overwhelmed with 18.1 mg. doses of mapharsen in nine hours. Findings: Mother—Slight hemorrhage under the pia about the basilar artery. Foeti A and B: Both foeti show great engorgement of all the intracranial vessels. There is hemorrhage into the mesenchymal tissue everywhere, especially at the base of the cochlea, and in the walls of the bulla cavity. Both foeti show large hemorrhages into the vestibule, the scala tympani and scala vestibuli, and into one semicircular canal. There is much hemorrhage into the bone marrow. The mother shows almost nothing, but both foeti show the most extensive hemorrhage of all the experimental animals.

rhage in the scala tympani both in the upper and lower whorls; section 15 showed hemorrhage in the modiolus



Broken Blood Vessel

Figure 31.—Pig No. 253. Foetus A. Findings: See Plate No. 22. The illustration shows two broken vessels in the scala tympani with a large hemorrhage about them. (Mapharsen pig.)



Hemorrhage in Semicircular Canal

Figure 32. Pig. No. 253. Foetus A8. x55. Mother overwhelmed with mapharsen, 18 mg. in 1 mg. doses in nine hours. Findings: Foetus A—Hemorrhage into bone marrow; subpial hemorrhage; hemorrhage in scala tympani; marked hemorrhage in scala vestibuli and one in semicircular canal.

about the VIIIth nerve. Forty serial sections were examined.

THE STRANGLING EXPERIMENT.

Pig No. 96: The opinion has been widely held for a long time that hemorrhages into the cochlea are best explained by the cerebral congestion accompanying lethal narcosis, chloroform being the usual agent employed. Considering the exposed nature of the cochlea vessels, I have felt that there was a good deal to this explanation. The following experiment, however, puts a damper on this theory as a major cause. A few months old pig was given just enough ether to make it unconscious and then it was slowly strangled to death by tight rubber bands placed about its neck. To my surprise, for I expected the opposite result, there were no hemorrhages in the 50 serial sections cut from the temporal bones of this animal. I have never seen a more normal cochlea.

FOUR PARAGRAPHS OF SPECULATION.

The amount of mesenchymal tissue in the middle ear, especially in the attic about the ossicles, is very striking. It can be considered histologically as elementary or potential fibrous tissue. Whitmarck has made much of its infection at birth and soon after. I have been struck with the possibility of its non absorption and its retention as fibrous tissue. The fibrous tissue in fetal bone is also striking. In my work on osteomyelitis I have been astonished how fibrosis of the marrow spaces of the frontal bone is found in connection with infection. The thought which occurs to me is whether or not infection can in any way set or fix the fetal fibrosis or in the adult start fibrosis in the bone marrow which by extension can do damage in places vital to hearing.

Hemorrhage into bone marrow may be absorbed or be replaced by connective tissue. The importance of such a happening depends on the location of the hemorrhage. I have found hemorrhage under the endothelium of the bulla creeping to the edge of the foot plate of the stapes.

The bulla cavity is ideal for testing the action of drugs on blood vessels and endothelium. Nature has made it a natural test tube. The mesenchymal tissue in the middle ear of the fetus could also be used to prove certain effects of drugs. The reaction of bone marrow to infection can be studied in the fetus now that we know that drugs are passed from mother to the fetus, and that probably infection does the same.

In studying feti, one of the most striking features is the mesenchymal tissue filling the middle ear about the ossicles and banked up against the round and oval windows. The next striking point is hemorrhage into this mesenchymal tissue about the malleus and incus, also near the round window and near the foot plate of the stapes after the administration of drugs. This mesenchymal tissue regularly becomes absorbed. Blood is easily absorbed, but one cannot help wondering if repeated hemorrhages or a single large hemorrhage might not leave behind fibrous tissue in embarrassing locations.

In the fetus, while the bones of the base of the skull are forming, the impression one gets is that most everything is, so to speak, snowed under by fibrous tissue. Again one wonders what would happen if there was an arrest of development and some of this fibrous tissue was retained in the wrong place. These are probably idle speculations, but I could not shake myself free of them.

CONCLUSIONS.

Small hemorrhages in the cochlea of the guinea pig are very common. They are generally found in the basal whorl in the scala tympani. Out of 24 adult guinea pigs, five were not given any medication and were used as controls. Of these, four showed slight hemorrhages in the cochlea; one did not. Trauma in the preparation of the specimen or in the mounting of the section or during life, a rise in the blood pressure of the cochlea vessels from any cause, I feel, are the probable causes of these frequent small hemorrhages.

When a hemorrhage is found in connection with the administration of a drug to an animal, congestion of the blood vessels of the cochlea in addition to the hemorrhage is necessary before the hemorrhage can be laid to the drug.

The vessels which supply the compartments of the cochlea emerge from their bony bed in the walls of the cochlea and become superficial, covered only by the endosteum of the cochlea. In their superficial course, the vessels are really large capillaries consisting of but one layer of endothelium. The endosteum of the cochlea which covers them also is one layer of endothelium. This mechanism allows the transudation of blood serum to make the lymph in the cochlea. It is

probable also that not a few red blood corpuscles gain the cochlea compartments by diapedesis from the blood vessels. The frequent presence of blood corpuscles overlying the blood vessels in the basal whorl is best explained in this way.

When there is extensive hemorrhage in the cochlea, serial sections of the specimen show that the hemorrhage often overlies a broken vessel. I have found this so often that I feel that all extensive hemorrhage is caused in this manner. To me this is a more satisfactory explanation than the commonly held belief that the blood reaches the cochlea from the cranial cavity and is an artefact due to the cutting of the meningeal vessels in the removal of the specimen at the autopsy of the animal.

The cochlea aqueduct is not an open canal; it is filled with a fine network of fibrous tissue and acts as a sieve. When there is much blood in the basal whorl of the cochlea the mesh work of the inner end of the duct is crowded with blood corpuscles, and corpuscles in diminishing amount are found to the cranial end.

One would expect and, in fact, we know that fracture of the skull involving the cochlea gives hemorrhage in the cochlea. In order to see what less severe trauma would do, an animal was killed by two blows on the side of the head which were not sufficient to fracture the skull. Abundant hemorrhage was found in the cochlea.

The belief has been widely held by investigators that the small hemorrhages so constantly found in the cochlea of experimental animals are due to the suffocation attending chloroform anesthesia. In order to check this theory; that is, as far as one experiment would do it, a pig was slowly strangled to death after primary anesthesia with ether by rubber bands placed about its neck. No hemorrhages were found in some 50 serial sections of the cochlea of this animal.

It has been known for years that quinine administered to adult animals would cause hemorrhages in the cochlea. It is known also that quinine appears in the mother's milk and has been found in the placenta.

The writer's experimental animals show that quinine, sodium salicylate and mapharsen fed to the mother, or injected, cause hemorrhages in the cochlea of the fetus.

Of the three drugs, mapharsen gave the most extensive hemorrhages. To my surprise, the cochlea of the mother of this pig showed no hemorrhages. To my surprise, also, the hemorrhages in this fetus were in the scala vestibuli, the vestibule and the semicircular canals, and were very extensive in all three places. In the quinine and sodium salicylate animals, the hemorrhages were practically always in the scala tympani. The amount and distribution of the hemorrhage in the quinine and sodium salicylate animals was about the same in both. These findings seem to indicate that quinine and mapharsen have a selective action on different parts of the inner ear.

A second pig was overwhelmed with mapharsen and one fetus gave a positive test for arsenic.

In the animals examined in this study, the vessels of the mesenchymal tissue of the middle and internal ear of the fetus were large, thin-walled, and were often found surrounded by hemorrhage. The favorite sites for hemorrhage into the mesenchymal tissue of the ear are the mesenchymal tissue surrounding the ossicles, the tissue covering the cochlea, especially at its base, and the mesenchymal tissue lining the bulla cavity.

The practical application of the findings which have just been given is that certain drugs pass from the mother to the fetus, as shown by similar findings in the mother and fetus. What is of importance to otologists is that what happens in animals probably also happens in man.

Some chronic squelcher of enthusiasm will say, at this point, that you cannot be sure that what happens in animals happens also in man. There is a grain of truth in this but no more. Given in man and animals, structures which are similar and serve the same fundamental physiological purpose, if you refuse to act on the principal that similar structures have similar function, you become a purist to the point of sterility.

Naturally I have been under obligation to many helpers in carrying out this investigation. Dr. Taylor sent me his very thorough bibliography on quinine. The main articles in this Dr. Lurie has checked from the original sources. The injection and the feeding of the animals with the drugs employed is a long drawn out affair, and so is the preparation of the sections. For this basic work I am indebted to Drs. Drooker, Snow and Wherry, House Officers at the Infirmary, and to the Throat Laboratory technicians, Miss Kendall and Miss Place. Dr. Slaughter checked the presence of arsenic in one of the feti of the second mapharsen pig.

828 Beacon Street.

CORRESPONDENCE—HOLMGREN.

The following was addressed to the Secretary of the American Otological Society, Inc., by Prof. Gunnar Holmgren, of Stockholm, the invited Guest of Honor of the Society. Illness in his family prevented Prof. Holmgren's attendance at the meeting.

Stockholm, April 12, 1938.

Dear Dr. Harris:

With thanks for your letter of March 29, I gather from same that you are willing to read a short message from me before the Society at its meeting in case I could send it by return mail. What is of special interest to you is my opinion as to the possibility of obtaining a fistula that will remain open for considerable time: I regret to say that it is quite impossible for me to give an exhaustive account of my point of view by return mail, but in case it would be of interest for the members of your Society, I can concentrate my opinion as follows:

1. It is possible to obtain permanently open fistulas of the labyrinth, but up till now this has been the case only occasionally with the material of Sourdille's and mine and there is no known method which leads to this goal.

2. The following are different ways for reaching this goal:

- a. Obtaining a fistula by means of lasting pressure. It is a known fact that fistulas caused by cholesteatomas remain open at a fairly great percentage. Cfr. Nylen, Doctor's Treatise, "A Clinical Study of the Labyrinthine Fistula Symptoms and Pseudo-Fistula Symptoms in Otitis." *Acta Oto-Laryngol.*, Supp. III, 1923.

- b. It is known that many metals are apt to prevent bone regeneration electrolytically.

- c. Radium and mesotorium in suitable doses give the same result. The stuff by means of which the fistulas are covered is perhaps of some importance.

- d. The making of another fistula in case of the first one having healed (Sourdille) is yet another possibility, but a time-absorbing one.

The experiments mentioned in paragraphs *a-d* have been made by me during collaboration with Dr. Norton Canfield, Yale University, New Haven, who was for some months working at my clinic. The material for these tests are monkeys. The histological investigations which Prof. Nager, in Zurich, has kindly promised to make, are going on but are not yet finished.

In addition to what is said above, my report before the Society chiefly aimed at showing the immediate results that can be reached by surgery in cases of otosclerosis. A series of patients have been audiometrically examined during the operation in order to make clear the importance of the different phases of the operation, *e.g.*, the opening of the antrum, the denudation of the saccus endolymphaticus, the making of the smallest possible fistula on a semicircular canal, the making of a wide fistula together with removing the endosteum and the covering of the fistula with different membranes.

GUNNAR HOLMGREN.

GRAPHIC ILLUSTRATIONS OF HEARING TESTS.*

DR. ALBERT A. CINELLI, New York.

The otologic literature on the functional testing of the cochlea with the tuning forks is richly supplied. Yet, it was most surprising to observe, through post-graduate teaching, how difficult it was for the average otolaryngologist to explain these physical tests of hearing in schematic form. It is with this thought in mind that this important academic topic is condensed as simply as possible in graphic illustrations.

Sound is a form of motion produced by some vibrating body. The normal ear appreciates musical notes between two extremes of pitch: the low, deep sonorous tone of 18 double vibrations per second, and the 41,000 double vibrations per second representing the upper tone limit.

The low notes are affected in conductive lesions because they represent long sound waves with slow vibrations of relatively great amplitude; whereas, tones of high pitch are produced by short waves with rapid vibrations of very small amplitude, and these are effected in the perceptive lesion.

The most important and practical tests used in otology to differentiate conductive deafness from perceptive deafness are: 1. Rinné Test; 2. Schwabach Test; 3. Weber Test.

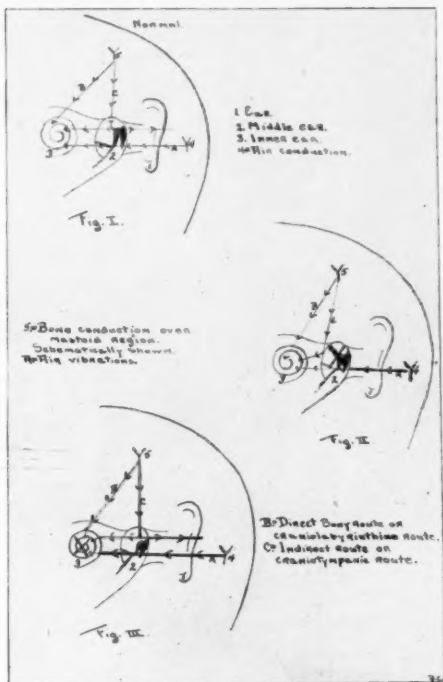
The Rinné Test: This test is a comparison of air conduction to bone conduction. In a normal hearing individual the air conduction is much longer than bone conduction. Place the vibrating fork upon the mastoid bone in the region of the antrum and when the sound is no longer heard then place the vibrating prongs near the external auditory meatus and observe how much longer the sound is perceived by air.

Fig. 1 illustrates the ear with no pathological lesion. The vibrating sounds by air conduction are seen to go directly to cochlea with no deflection whatever. They reach the cochlea via external ear, tympanic membrane and ossicular chain to the inner ear. The vibratory sounds from the mastoid region

*From the Ear, Nose and Throat Department of the New York Post-Graduate Medical School of Columbia University.

Editor's Note: This ms. received in Laryngoscope Office and accepted for publication, April 23, 1938.

reach the cochlea by bone conduction by two routes—B is a direct bony route to the cochlea called craniolabyrinthine route, and C is the indirect route (craniotympanic) going to the middle ear. Here there is a deflection of the vibratory sound, partly going to the cochlea and partly going to the external ear to be lost. Since no vibratory sound has been lost through air conduction, therefore it is greater than bone

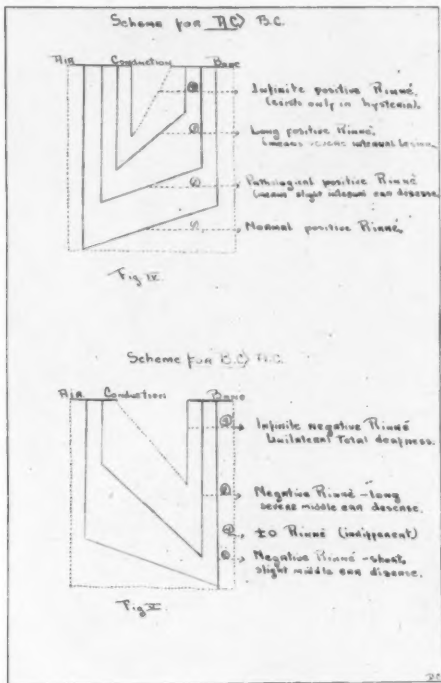


conduction. This is represented by $A.C. > B.C.$, and is called Positive Rinné.

Fig. 2 represents a middle ear or conductive lesion. The vibrating sounds coming through by air conduction (A) are chiefly lost because of the middle ear pathology and a small portion reach the cochlea. The vibratory sounds coming from the mastoid region through its direct (B) route and also its indirect (C) route are both carried to the cochlea intact.

The sounds which are ordinarily lost from the indirect route, as in the normal case, are deflected back to the cochlea because they are obstructed in reaching the external ear by the lesion in the middle ear. Therefore, $B.C. > A.C.$ This is called Negative Rinné, and is found in lesions of the middle ear.

Fig. 3 represents an internal, perceptive or nerve lesion. The vibratory sounds are very much diminished, both from



air and bone conduction, in reaching the cochlea because of the lesion contained therein. However, the relation between air and bone conduction is the same as in Fig. 1, but shortened. This is called Pathological Positive Rinné $A.C. > B.C.$, contra-distinguished from the Normal Positive Rinné.

Fig. 4 represents all the forms of Positive Rinné. Graphically, the relation between air conduction and bone conduction is seen in the various degrees of deafness.

1. *A.C. > B.C.* This is a Normal Positive Rinné and present in normal cases.

2. *Pathological Positive Rinné.* If pathology in the inner ear is slight, then air conduction is slightly longer than bone conduction, but both diminished.

3. *Long Pathological Positive Rinné* shows the air conduction much longer than the bone conduction, but both markedly diminished from normal. Found in severe types of nerve lesions.

4. *Infinite Positive Rinné*, when there is no bone conduction whatever. This cannot exist because one can always hear from the bone conduction on the other side. This exists only in cases of hysteria.

Fig. 5 represents all the forms of Negative Rinné.

1. *B.C. > A.C.* This is a Short Negative Rinné, because the bone conduction is slightly increased and the air conduction slightly diminished. This is present in slight middle ear diseases.

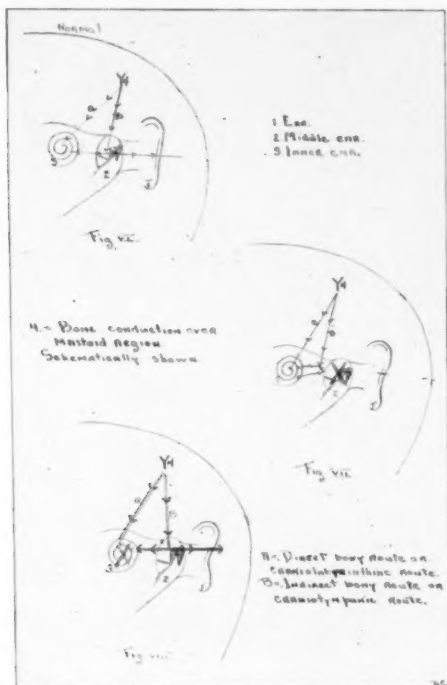
2. *Long Negative Rinné.* The bone conduction is much longer than the air conduction, but both diminished from the normal level. This is found in severe type of middle ear lesions.

3. *Infinite Negative Rinné.* There is no air conduction at all. This is typical of total deafness. The bone conduction heard here is usually coming from the other side.

4. *Indifferent Rinné*—the plus and minus form. There are two varieties. First, that in which the air and bone conduction are of equal length, because the air conduction is slightly diminished and the bone conduction slightly increased, the hearing is good in this form in which a slight middle ear condition is found. Second, air and bone conductions are equal in duration, but both much shorter than normal. Hearing is very poor and found in far advanced nerve lesions.

The Schwabach Test is a comparison of bone conduction of patient to normal ear of examiner—Fig. 6. Physician examining patient tests own bone conduction and is normal. Fig. 7 shows a lesion in the middle ear of the patient. Bone

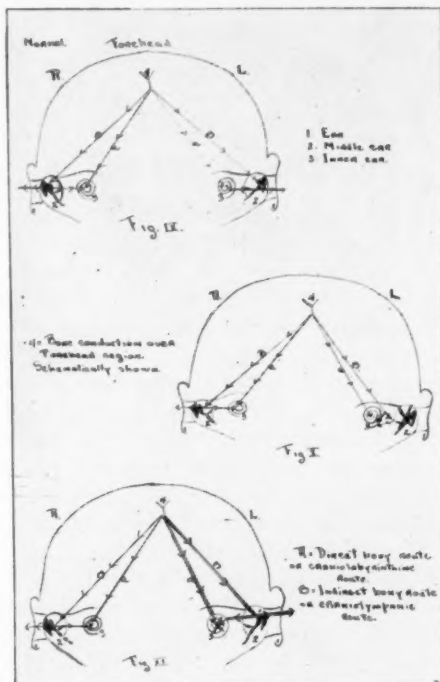
conduction here is longer than the bone conduction of Fig. 6, because the deflected sound waves from the indirect route are re-deflected into the cochlea because of the lesion in the middle ear. This is called "Schwabach Increased." Fig. 8 shows a lesion in the inner ear of the patient. The bone conduction here is readily seen to be shorter than Fig. 6. This is called "Schwabach Decreased."



The *Weber Test* is utilized for the lateralization of sound. Fig. 9 shows no lateralization of sound in a normal case, because the sound is distributed equally on both sides when placing the tuning fork on the forehead.

Fig. 10 represents a lesion in the left middle ear. The vibratory sounds on the diseased side are not lost, because they are reflected back to inner ear; whereas, on the sound side, part of the sounds coming from the indirect route are

lost which pass out through the external ear. Since the sound is more intensified on the diseased side, it is called "Weber lateralized to the same side." Fig. 11 represents a lesion in the left internal ear. The vibrating sounds coming from both direct and indirect routes are chiefly lost; whereas, on the sound side only a small fraction of the indirect route is lost.



Since the sound is more intense on the normal side, it is called "Weber lateralized to the opposite side."

SUMMARY.

1. Lesions of the left external and middle ear or conductive type deafness give the following functional results: 1. Rinne negative. 2. Schwabach increased. 3. Weber lateralized to same side. 4. High notes heard well. 5. Low notes heard badly.

2. Lesions of left internal (nerve) ear or perceptive type deafness give the following functional results: 1. Rinné pathological positive. 2. Schwabach decreased. 3. Weber lateralized to the opposite side. 4. Low notes heard well. 5. High notes heard badly.

1021 Park Avenue.

AMERICAN OTOLOGICAL SOCIETY, INC.

The Seventy-first Annual Meeting of the American Otological Society was held under the Presidency of Dr. Harris P. Mosher, of Boston, at the Hotel Claridge, Atlantic City, May 5 and 6, 1938. The attendance of both members and guests was large. In the uniform excellence of the papers presented, as well as in the manifest interest shown by those present, the meeting maintained the high standard attained by the Society.

On recommendation of the Council, Prof. Gunnar Holmgren, of Stockholm, Sweden, was elected an honorary member, and the following were elected active members: Dr. William E. Grove, Milwaukee; Dr. James Swift Hanley, New York; Dr. Voss Harrell, Detroit; Dr. John Devereaux Kernan, New York; Dr. Fletcher Woodward, University, Va.

The following were elected to compose the Council for the year 1938-39: Dr. Isidore Friesner, New York; Dr. Horace Newhart, Minneapolis; Dr. Thomas J. Harris, New York; Dr. Harris P. Mosher, Boston; Dr. Edmund Prince Fowler, New York; Dr. D. E. Staunton Wishart, Toronto; Dr. Gordon Berry, Worcester, Mass.

The Council, under authority of the By-laws, elected as officers for the ensuing year: Dr. Isidore Friesner, President; Dr. Horace Newhart, Vice-President; Dr. Thomas J. Harris, Secretary-Treasurer.

The American Board of Otolaryngology reported that it had held two examinations during the year and examined 200 candidates. The total number of certificates granted to date is 2,668.

**VOLITIONAL DEAFNESS VERSUS MALINGERING OR
SIMULATION OF DEAFNESS.—A COMPARISON
OF OTOTERMINOLOGIC VALUES.**

DR. CHARLES FIRESTONE, Seattle.

The otologist who is frequently called upon to establish the degree of permanent injury to the auditory mechanism resulting from compensable industrial injuries, or to testify to the total absence of such permanent injuries in the face of an injured workman's claim that such a disability does exist, very often finds the use of the term *malinger* an anathema, and in a good percentage of cases a term which injures his prestige before the court of justice and which contributes to the ultimate miscarriage of justice in many of these cases. This term places the otologist in the position of having made a very positive statement, not only as to the state of the injured workman's auditory condition, but also as to his honesty and his character, and throws the onus of proof on the otologist rather than on the individual feigning the deafness, to whom it rightly belongs. Human nature being what it is, and the courts of law that are called on to adjudicate such disputes being of human composition, justice in the end is better served when diplomatic, as well as more definitive terminology is given consideration. If the injured workman brings his case into court before a solitary judge, we may at least expect a verdict from a person having a better than average background in education and in knowledge of human traits and foibles, and in some cases a better than average amount of innate intelligence. The attorney for the injured workman is, however, conversant with this latter fact, and at least in the State of Washington seeks and, in many cases, effects a jury trial. The underdog(?) is thus assured his day within the portals of justice, and the otologist and the specialty of otology in general is certain to lose some esteem in the eyes of the judicial peers, convened ostensibly to judge the injured workman's veracity of statements, but in reality to judge the ability of the otologist to demonstrate objectively the otologic state of affairs as compared to the attorney's

Editor's Note: This ms. received in Laryngoscope Office and accepted for publication, March 5, 1938.

ability to prove the claimant's contention. In effect, it is the ability of the otologist that is tried before this august body in the end. If the otologist is unsuccessful in making his tests intelligible to the jury, the claimant gets the award, regardless of the merits of his claim.

In the State of Washington, traumatic neuroses in all their manifestations are compensable by the Department of Labor and Industries. Each traumatic case thus becomes *ipso facto* a potential traumatic neurosis; from then on, all claims and actions become justifiable. The attorney for the injured workman routinely calls on the state's otologist to demonstrate objectively before the court by what means he arrives at his conclusion. The otologist proceeds by his objective means to demonstrate to the court. If the demonstration is unsuccessful from the laity standpoint, the attorney rests his case there. If the demonstration is successful, the attorney veers his interrogations into the sphere of the neuropsychic field, somewhat in this vein: "Doctor, have you ever heard of neurotic deafness?" or, "Can a neurosis manifest itself in periodic deafness; and do you, Doctor, believe that the injury sustained by this workman could have produced a neurosis?" If the otologist replies in the negative, he is asked on what background of training he gives this opinion. If his reply is in the positive, the questioning ceases there, as the attorney has proven his case. If he replies noncommittally, he immediately divorces the value of his testimony from the case at hand. By this last reply he literally removes himself from any value in the case and glitteringly hands the case over to the speculations and conclusions of the attorney, sometimes aided by a psychiatrist. The otologist thus surrenders his domain, with head somewhat bowed, to the realm where it does not belong and where at best it can only receive hazy and circumstantial treatment.

This writer has had considerable experience with otomedicolegal work in his state. In his experience he finds, in the State of Washington at least, that the otologist with his armamentarium for detecting malingering is very often put on the defensive by the very term "malingering." In 1934, this writer published a test which he devised for the detection of simulation of deafness¹ and which, regardless of its other merits, has proven more comprehensible to the laity in his hands than other malingering tests; however, as stated

above, even if malingering is proved, the otologist is met with the question of neurotic deafness. This writer has, therefore, been led to discard the term "malingering" or "simulated deafness" in favor of "volitional deafness." The latter he has found of more than didactic value. As soon as the attorney for the injured workman veers his questioning into the field of neurotic deafness, the otologist is not discarded from the picture. Volition being a component part of the *normal* personality, the otologist is considered just as capable to give an opinion on that as is the psychiatrist, inasmuch as the latter is taken as qualified in abnormal psychology, but is not taken as possessing any more knowledge of normal psychology than the otologist. The instant the attorney attempts to move the claim at hand into the neuropsychic field, this writer veers his tactical procedure in the normal psychologic field by the term of "volitional deafness," which, of course, is identical with malingering, but which throws the onus of proof on the attorney and his psychiatrist (if he has one), and does not tend to disqualify the otologist in the case. It clearly puts the attorney on the defensive, inasmuch as he has to do the proving to the jury that the claimant is suffering from a neurotic deafness rather than a volitional deafness. Since volitional deafness is nothing but an interposition of the claimant's will in the path of normal reaction to auditory stimuli, the otologist is placed on an equal footing to defend his findings. So far as this writer knows, no court of law has established the psychiatrists' superiority in the field of normal psychology over that of any physician, regardless of his chosen field.

To sum up, this writer finds the term "volitional deafness" preferable to "malingering" or "simulated deafness" in otomedicolegal cases. Since volition is one of the normal composites of the normal personality, the onus of proof that a claimant's interposition of his volition in the normal response to auditory stimuli is abnormal to this particular patient, rests on the attorney for the claimant and is thus shifted from the otologist. The otologist merely establishes objectively his conclusions; the psychiatrist deals in abstractions and eschews objective proof. Juries, being what they are, will attempt some weighing of the objective proof of the otologist on the one end and the abstract theorization of the psychiatrist on the other. At least the otologist is not completely discarded

as a noncompetent as a consequence of the attorney's shifting of the case into the neuropsychic field. Under these circumstances the claim is more apt to be tried on its merits. With the use of the term "malingering," it is the ability of the otologist that is apt to be on trial rather than the veracity of the injured workman's claim. This terminology may also be applied to visual and other malingerings in which claimants seek unjust compensation.

REFERENCES.

1. FIRESTONE, CHARLES: Test for Simulation of Deafness. *THE LARYNGOSCOPE*, Vol. XLIV, No. 3, pp. 211-218, March, 1934.

1433 Medical-Dental Building.

BACTERIAL OTITIC MENINGITIS. A CASE REPORT.*

DR. EDWARD R. ROBERTS, Bridgeport, Conn.

This paper records an otitic illness following an upper respiratory infection, with septic manifestations, bacterial meningitis, and recovery, in which the use of sulfanilamide seems to have been a favorable influence. This otitic illness extended over a period of 49 days, to include 36 days of hospitalization, during 26 days of which the patient was desperately ill.

S. R., male, age 38 years, was admitted to the Bridgeport Hospital on Dec. 26, 1936, complaining of intermittent bilateral earache, diminution in hearing, weakness and feverishness. Ten days before he had had a bilateral myringotomy for acute purulent otitis media.

The family and past histories are irrelevant.

The admission temperature was normal, but promptly rose to 102°. The patient appeared tired and toxic. Physical examination was negative except for bilateral purulent middle ear discharge and questionable tenderness at the left mastoid tip.

During the first 10 days of hospitalization, Dec. 26 to Jan. 5, the white cell count ranged from 20,500 to 12,000, and the hemoglobin from 92 per cent to 86 per cent. Lung pathology was excluded by X-ray, and a left upper devitalized molar tooth was extracted. Above this was a purulent maxillary sinus which had been treated by inferior meatal puncture and irrigation.

His deafness was marked, hearing ranging from 1 to 6 feet for the conversational voice. There was no physical signs of mastoid disease. The cultures of the middle ear discharge showed staphylococcus aureus. Mastoid X-rays were indicative of mastoid involvement.

Tests for typhoid and undulant fever were negative. Medical treatment was symptomatic and supportive, including the ultra-violet rays, viosterol and insulin.

*Read before the New York Academy of Medicine, Section on Oto-Laryngology, Feb. 16, 1938.

Editor's Note: This ms. received in Laryngoscope Office and accepted for publication, April 22, 1938.

On Jan. 8, the temperature had reached 105° on five successive days. The patient was drowsy and listless. Influenced by an extension of the pathology in a second X-ray series, I performed a simple mastoid operation on the left side, with exposure of the lateral sinus. Blood cultures had been reported negative on Jan. 6 and 8. The tympanic membranes were mildly inflammatory in appearance. The myringotomy wounds were widely open. The white cell count had dropped 50 per cent; hemoglobin was 82 per cent.

At operation there was no bone destruction. The antrum and one large cell half way down behind the posterior canal wall were filled with a greenish fluid. While working in this area there was an occasional swirl of white material, presumably pus, which would swim around in a puddle of blood. Following this further, posteriorly and inferiorly, it was found to have come from a large cell behind, below, and partially internal to the posterior wall of the lateral sinus.

Cultures from this mastoid pus yielded *staphylococcus aureus* and hemolytic *streptococcus*.

Because of the presence of the hemolytic *streptococcus*, sulfanilamide was added to the medication. This was on Jan. 8, 1937, before the comparative value of the mouth and intramuscular preparations of this drug had been evaluated. An intramuscular preparation was chosen. Pink tinged skin and mercurochrome-like stained urine was noted.

On Jan. 8, the temperature reached 106.5° , and the hemoglobin was 78 per cent, the lowest of the illness.

On Jan. 10, there was some rigidity of the neck, but no other meningeal signs. On Jan. 11, a third blood culture was reported negative. A direct blood transfusion of 600 cc. was given. On Jan. 13, many pustules appeared on the neck and back. Repeated cultures from the pus in these pustules exhibited *staphylococcus aureus*.

The patient's condition remained unchanged. temperature ranging from 102.5° to 105.5° . After a second transfusion, I performed a simple mastoid operation on the right side, Jan. 14, with exposure of the lateral sinus and dura, and liberal re-exposure of the lateral sinus and exposure of the dura on the left side, further exposing the dura of the middle fossa.

The anatomical findings in the right mastoid were about the same as on the left, including the large cell somewhat internal to the lateral sinus posteriorly. It was not involved; in fact, only an occasional cell showed infection, but with the same white exudate or pus. Cultures from this mastoid wound showed no growth.

A lumbar puncture done just before operation showed: Fluid, cloudy; cell count, 2,544; polys., 90 per cent; small lymphocytes, 10 per cent; globulin, 4+; spinal fluid sugar, 20 mg. per 100 cc.; no growth on culture.

A tap done Jan. 15, the day after the operation, showed: Fluid, cloudy; cell count, 874; polys., 96 per cent; small lymphocytes, 4 per cent; globulin, 3+; spinal fluid sugar, 29.5 mg. per 100 cc.; culture showed growth of gram positive cocci after three days subcultures and incubation hemolytic streptococcus.

Sulfanilamide had been administered continuously intramuscularly since the identification of a hemolytic streptococcus in the culture taken from the first mastoid wound. Jan. 19, this method of administration was discontinued and the drug given orally until the end of the illness.

For the six days after the second operation the patient was in a state of mental confusion, incontinent, with stiffness of the neck, hyperactive deep reflexes, absent superficial reflexes, and a Babinski on the right, which over these six days became more and more definite. On the sixth day after the second operation the patient developed a second crop of pustules over the neck. He was transfused again. Once more the staphylococcus aureus was cultured out. On this day, Jan. 21, the highest temperature recorded was 102, and from then, gradually, by lysis, the temperature reached normal.

The patient's mental and meningeal status gradually improved, so that within two weeks postoperative (second operation) he was thoroughly orientated, with the neck flaccid and reflexes practically normal.

Noticeable throughout the illness was the absence of much severe pain in any location, and although chilly at times, he did not experience a pronounced chill.

The operative wounds healed without event, the left in 23 days, and the drum in 15 days; the right in 17 days, and the drum in 23 days. The patient was discharged from the hospital, recovered, on Feb. 5, 1937.

The total amount of intramuscular sulfanilamide given was 400 cc., and of the mouth preparation, 690 gr.† At intervals the patient had been sufficiently cyanotic to reduce the dosage of the drug, but at no time was it withdrawn altogether. There was a 22 per cent (35 lbs.) loss of body weight during this illness, all of which was regained by April 2. Hearing gradually improved. Bone conduction and the hearing were normal on May 2.

SUMMARY AND CONCLUSIONS.

1. A case of otitic streptococcus meningitis with septic manifestations with recovery, treated by the usual conventional methods plus the use of liberal persistent doses of sulfanilamide, is added to those already recorded.

2. The pathological behavior of the middle ear or the absence of it was unusual, but consistent with the findings at mastoid operation.

3. It may be assumed that the hemolytic streptococcus when identified in the spinal fluid was of low virulence and was inactivated by the use of sulfanilamide.

4. The use of sulfanilamide in otitic infection of streptococcus origin should be accepted. It is important to ascertain if this drug should be used early during the period of an uncomplicated suppurative otitis or reserved for use in event of the development of more serious complications for which treatment at our disposal is not satisfactorily effective.

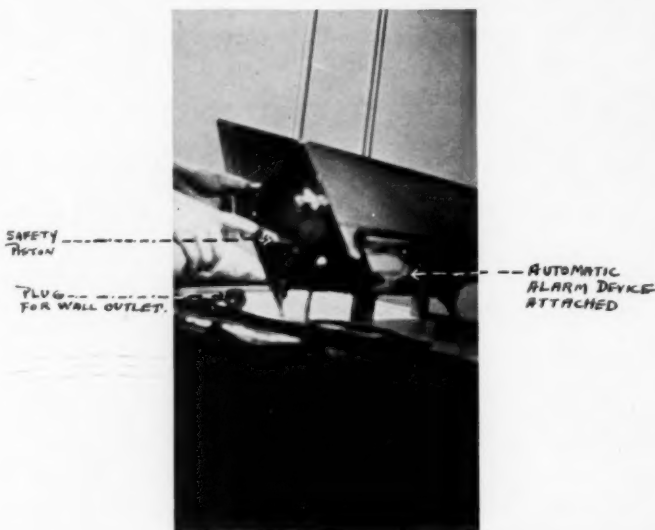
144 Golden Hill Street.

†Administered under the guidance of Dr. H. LeBaron Peters, Attending Physician, Bridgeport, Hospital.

AN AUTOMATIC ALARM SOUNDING STERILIZER.

DR. M. MARTYN KAFKA, Brooklyn.

This instrument is devised with the view of presenting to the medical profession an automatic device attached to the electrical sterilizer which will, upon the complete disappearance of water, sound an alarm. This alarm can be arranged according to the type of sound desired.



The alarm sounds when the safety valve is released; this in turn compresses a small lever in the device which will create the alarm. The advantage of this type of sterilizer is obvious. Often instruments are left within a sterilizer, even though the safety piston is released. When the sterilizer is closed, with instrument therein, there is a tendency for all instruments to rust, even though the switch has been disconnected by the safety piston. The advantage of this type of sterilizer is that not only is the safety piston released, but

Editor's Note: This ms. received in Laryngoscope Office and accepted for publication, April 15, 1938.

the alarm continues to sound until the safety piston is placed back in its original place, thus preventing rusting of valuable instruments.

No matter in what room the physician or his assistant might be, this alarm can be heard providing it is on the same floor; however, additional wiring can relay the sound to the upper floors if necessary.

807 St. Marks Avenue.

THE ROLE THAT SURGERY OF THE PARANASAL SINUSES PLAYS IN THE ASTHMATIC CHILD.*

DR. RAYMOND C. CREASY, New York.

Medical science, from its infancy, has probed into the darkest recesses of disease with but one aim—to bring surcease to suffering humanity. Never has research carried on more painstakingly than when its interest has been directed into the abysmal complexities of the dread scourge, asthma, which has ravaged childhood with relentless fury. Disappointment and discouragement beset the path of any pioneer undertaking before hope dawns. But the indomitable courage and undying faith of the scientific pioneer has been as unflinching in this endeavor as that of his prototype, who forged the wilderness trails in search of new frontiers.

This investigation was actuated by clinical observations of the ravages of asthma in children, and especially when retention and absorption of the products of the paranasal sinus infection was a causative factor.

Statistical evidence is presented on the therapeutic value of surgical intervention for the production of the reventilation of the nasal chambers and paranasal sinuses, and its beneficial influence, rendering many cases subjectively asymptomatic, including the asthmatic paroxysms.

A study at the New York Post-Graduate Hospital of 60 children, age 5 to 14 years, presenting the asthmatic syndrome, in association with paranasal sinus infection, is submitted.

In all the cases secondary infected adenoid growths and infected tonsil remnants were evident. There were paranasal infections of varying degrees. In some cases only one sinus was involved, while in others a pansinusitis was observed. Roentgenological evidence supported my clinical observations.

Roentgenological Findings and Operative Procedure: Impressive were the Roentgenological findings. Five children, or 8-1/3 per cent, showed a slight veiling or edematous changes. Here conservative correction of the deviated septum by fracturing and replacing in a normal position was

*Read before the New York Academy of Medicine, Section on Oto-Laryngology, Feb. 16, 1938.

Editor's Note: This ms. received in Laryngoscope Office and accepted for publication, April 22, 1938.

employed, and the position retained by means of nasal splints. Eight children, or 13-1/3 per cent, showed a membranous antritis on the right side, while one had a definite membranous antritis on the left side. Twenty-one, or 35 per cent, exhibited a combination antritis and ethmoiditis. Seven of the 21 had antritis and ethmoiditis involving the left side, and 14 a right antral and ethmoidal involvement. Five, or 8.3 per cent, bilateral ethmoiditis and infection involving one antrum. Seven, or 8.23 per cent, showed a bilateral antritis. Six, or 10 per cent, a bilateral antritis and ethmoiditis. Three, or 5 per cent, bilateral membranous antritis. Two pansinusitis (maxillary, ethmoid, and sphenoid). The ratio of infection relative to sex was, three male to one female.

The technique in this series of cases consisted of careful reduction of stout ridges and spurs beneath the mucosa. Collapsing any cystic degeneration of the turbinates and replacing this structure as nearly as possible in its normal position. To achieve favorable results the antrum cavity was ventilated by a permanent intranasal antrotomy, establishing an artificial nasal antral communication; to do this permitted the child to reach his teens more mature in growth, development, and mental alertness. In all cases residual tonsil and adenoid remnants were removed.

In these procedures, conservatism has been the guiding theme. No vital structures were removed and sinus cavities in this manner were reventilated either by direct ventilation or indirectly by improved nasal ventilation.

Etiological Factors in Bronchial Asthma: In addition to allergy, a highly specialized field, which will not be invaded here, there may be other factors in bronchial asthma which make it difficult to differentiate when two or more causes are contributory. We are cognizant of the diseases of an infective character common to children, as well as infections of the tonsil and adenoid tissues, and ordinary acute coryza associated with the unresolved cervical adenopathy, as habitually a foundation for paranasal sinus infections and associated asthmatic symptoms. Purulent fluid permitted to remain in the nares, ever present in the infant who may be suffering from a head cold, and the exanthemata, will cause considerable destruction of structures in contact with purulent fluid. Evidence of periosteal and perichondral erosion will be revealed during subsequent years by the formation of stout

ridges, spurs and septal deflections, especially at the articulating joints of parts composing the septum, and the turbinate structures lying adjacent to the ostei. Osseous hyperplasia and its associated distorting forces menace the ventilating space of the nasal cavities and if great enough will diminish sinus ventilation and produce retention of bacteria within these areas.

Pathologic transformation of fibrous articulating joints of parts making up the septum, misdirecting the tidal air with the usual resulting disturbances. In view of these facts it is most urgent that the medical adviser definitely assumes the responsibility for the removal of this purulent fluid from the nasal cavity, reducing the hazards to the child's health during the acute process.

Nature has endowed man with an upper respiratory system consisting of its many varied dissimilar functions, one of which by reason of extensive distribution of lymphoid tissue and numerous ventilating cavities, is to protect the individual from invasion. Regardless of how great this fortification may be, whether from lowered resistance, indigent environment, malnutrition, or exposure, early tissue reaction is the result of the invading micro-organisms in an attempt to resist invasion. It may ultimately fail because of the repeated infective process, resulting in a persistent vicious circle.

Nature, in her attempt to repair, creates a nasal stenosis, which induces sinus infection due to deprivation of the tissues of needed oxygenation. This tidal air to and from the lungs no longer bathes this delicate mucosa, which is vitally necessary for its normal existence. In consequence there may also follow other functional disturbances of the respiratory system. Tonsils and adenoids are frequently removed routinely without regard to the stenosis that might exist.

The superficial excision of adenoid tissue in the most accessible region, allowing that portion to remain in Rosenmüller's fossa, as well as the deep layer adjacent to the preventible facia, is certainly a technique to be deplored. Incomplete removal of tonsils likewise spells calamity. Infections within these parts, according to laboratory reports, is the commonplace habitat for micro-organism. Speed must never replace efficiency.

Operation Prerequisites: Let us bear in mind that poverty and lack of opportunity alone do not handicap these suffering

children. Many without operative intervention are destined to be dwarfed physically and mentally, personalities imprisoned through indifference and neglect.

Whether and when to operate constitutes a weighty decision. Growth and development in the child may influence the subjective symptoms beneficially. However, it appears to me far more important to restore the general health of the child in those cases where operation is deferred than to neglect this and operate during adolescence. Before selecting the child for operation the existing conditions should be weighed Roentgenologically and bacteriologically. We must evaluate the child in terms of congenital nasal structural abnormalities which may be an ancestral heritage and be aware of the role they play as predisposing etiological factors. That has been accepted by many as being true, yet they fear to exercise surgical measures lest they dwarf growth and development of the nose and mar the facial expression. This element of uncertainty should be eliminated before selecting the child for operation. Consider the gravity of existing symptoms, parent co-operation, hospitalization during the convalescent period, and obtain a complete understanding in regard to post-operative avoidance of exhaustive expenditure of energy and allay all extrinsic factors relative to inducing irritability.

An apparent difference of opinion has existed between the general practitioner and the specialist as to whether this problem should be dealt with in childhood or early adolescence. However, the successful surgical results in this series are pertinently significant and a more mutual understanding may be established.

It should be emphasized that when operative intervention is undertaken in an attempt to readjust intranasal structures, facilitating drainage and increased oxygenation, a routine cleansing of these parts must be carried out over a prolonged period of time. Unless this is done meticulously, the surgical intervention will be a failure.

The importance of the assistance of the allergist during post-operative treatment is essential if the asthmatic child is to become symptom free. To allow allergic elements to go untreated during this period only temporary results will accrue and continued action of this extrinsic element may again re-establish sinus infection.

Results: Fifteen of these children, or 20 per cent of the cases, have been definitely clinically asymptomatic from one to two years, and became definitely symptom free immediately after the operation. Thirty-three, or 55.55 per cent of the cases, became symptom free during a period of one to three months, and with the exception of an occasional very mild attack of asthma, associated with acute coryza or acute influenzal tracheitis, weight has been gained, loss of mental sluggishness and general health restored. These same children who have responded so well were definite asthmatic invalids preoperatively, suffering intermittently from attacks of such intensity and frequency as to require either hospitalization or home treatment in bed. In three cases where there was no parent co-operation, results were negative, indicating that this co-operation is vital. In three cases where parent co-operation has been excellent, operative intervention failed to restore health and relief from asthmatic symptoms because of an existing extrinsic allergy. In six cases the improvement has not been established.

Postoperative Sequela: The postoperative sequela consisted of the ensuing complications: One bilateral mastoiditis; one scarlet fever, postscarlatinal mastoiditis; one pyelitis; four acute otitis media (requiring myringotomy).

Considering the fertile bacterial fields and the infections within these adjacent structures before operation, the postoperative sequela were surprisingly few.

CONCLUSIONS.

The observations in this series have been within an approximate period of three years. Naturally, each individual will engage our attention further, and I predict that at the expiration of three to five years, conclusive statistical statements will be available to prove that a higher percentage of symptom free children will be established.

With this candid confrontal of truths, it is my firm, sincere conviction that conservative surgical correction of structures within the nares and reventilation of the infected sinus cavities to which the technique alluded in this paper plays a leading role will undoubtedly assist in the rehabilitation of the health of the asthmatic child and his eventual cure.

30 East 40th Street.

USE OF UNDENATURED BACTERIAL ANTIGEN IN CHRONIC SUPPURATIVE SINUSITIS.*†

DR. A. NEIL LEMON, Philadelphia.

It is unfortunate that chronic suppurative sinusitis has been the bone of contention of rhinologists for years. This has especially been the case in ethmoidal involvement. In the rhinolaryngological clinic of Temple University Hospital all the various methods of treatment, including cleansing, suction, tampons, vaccines, Proetz treatment and surgical exenteration are used. Forty cases of chronic suppurative sinusitis which had failed to respond to other treatment were treated by combined topical and systemic immunization with Krueger's undenatured bacterial antigen over a period of 18 months.*

The writer wishes it clearly understood that the preparation was used only in cases of chronic suppurative ethmoiditis and pansinusitis. The chronic maxillary cases are not included in this review.

The undenatured antigen differs from the ordinary bacterial vaccine in that its preparation is by grinding of the germ growth and filtration rather than by treating with either heat or chemical agents.

The experiments of Anson and Mirsky¹ revealed the remarkable ease with which denaturation of protein may proceed under a variety of chemical conditions. It manifests itself in altered physical and chemical properties of the protein, and these changes are reflected in altered antigenic activity, proceeding even to the complete loss of antigenic activity.

Krueger² feels that when heat or chemicals, or both, are used for killing bacteria there results partial or complete denaturation of the bacterial cell proteins with modification of the bacterial protein structures and immunologic properties. When such a preparation is injected, there is produced a response in the host which may be indicated as follows:

*Read before the Philadelphia Laryngological Society, April 5, 1938.

†The materials used were Respiratory "U. B. A." (Undenatured Bacterial Antigen, Lilly) and Respiratory, Topical, "U. B. A." furnished through the courtesy of Eli Lilly and Company, Indianapolis, Ind.

Editor's Note: This ms. received in Laryngoscope Office and accepted for publication, April 8, 1938.

a nonspecific response to metabolites, peptones, and proteins of the medium in which the micro-organisms were grown; a nonspecific response to the denatured proteins in the heat-killed bacteria; specific response to the residual undenatured antigen in the bacteria; specific response to the variable quantity of undenatured antigen released by autolysis; and specific antitoxic immunity to bacterial toxins secreted into the medium.

Krueger's *modus operandi* is as follows: Mass cultures of bacteria are grown in Blake flasks on appropriate media. The cells are harvested in buffered isotonic solution and washed five or six times to remove metabolites. After final centrifugation the bacteria are suspended in the buffered solution (Locke-Ringer's) and the cell count determined by the centrifuge sediment method. The dense suspension is ground in a mechanical grinder for 10 to 18 hours. Intact bacterial cells which escape grinding are removed by ultrafiltration through a 4.5 or 5 per cent acetic collodion membrane.

The water-clear filtrate contains those constituents of the bacterial cell put into solution or suspension by physical rupture of the cell membrane. There have been excluded immunologically undesirable elements, such as metabolic and degradation products consequent to heat or chemical treatment of the bacteria used in orthodox methods of vaccine preparation. Standardization of the sterile filtrate is on the basis of the nitrogen content per 100 cc.

Since the undenatured bacterial antigen prepared by the Krueger method contains only the unaltered bacterial cell constituents, its use is attended with a minimum of non-specific reaction. The content of native bacterial antigens is higher and it produces a marked specific antibacterial immunity.

The respiratory undenatured bacterial antigen contains the antigenic fractions of pneumococci, streptococci (hemolytic, viridans, and indifferent strains), staphylococci, *Hemophilus influenzae* and *Micrococcus catarrhalis*.

The topical solution contains the unaltered antigenic fractions of the same micro-organisms, prepared in a peptone solution designed to enhance the permeability of the sinus mucosa.

The generally accepted method of systemic administration of the respiratory undenatured antigen is as follows: One-tenth cc. is given intradermally and 0.1 cc. subcutaneously as the first dose. At each succeeding injection the subcutaneous dose is increased by 0.1 cc., while the intradermal dose remains at 0.1 cc. The maximum subcutaneous dose is determined by the judgment of the administrator, the tolerance of the patient, and the progress made. Womack³ advises 0.5 cc. as the maximum subcutaneous dose. He injects 0.1 intradermally and carries the needle subdermally for the deeper dose without making a separate skin puncture. The topical form of the undenatured bacterial antigen may be applied directly to the infected area or into the posterior sinus group by Proetz displacement technique.

Womack, in treating 53 acute cases, had satisfactory results in 40 per cent of them in 24 hours; in 31 per cent in 48 to 72 hours; in 25 per cent in 120 hours; no improvement in 4 per cent.

The writer questions the value of any such therapeutic measure in acute cases. Many of these cases improve in three or four days with no treatment and many of them do not improve with various types of management. Relief comes when hyperemia subsides or when pus is released and any form of therapy being used at the time would naturally receive credit.

In treating 45 cases of chronic sinusitis with autogenous respiratory undenatured bacterial antigen prepared by Krueger, Kracaw⁴ reported improvement in 95 per cent and marked improvement or cure in 66 per cent. He administered the antigen according to the dosage schedule above described, using 10 or 12 doses of a weaker solution and 10 or 12 of a stronger one. The maximum subcutaneous dose of each strength was 0.5 cc. to 0.8 cc.

A year or more after completion of treatment in the previously reported series of 45 cases, Kracaw⁵ found that 28 of the 30 patients considered cured had maintained that status, while the 13 patients classified as presenting satisfactory clinical improvement all remained in that category.

A second series, comprising 62 patients suffering from chronic sinusitis were treated in the same manner. Of these,

52 were markedly improved or cured; eight showed moderate improvement, and two were failures. On a percentage basis, the last series revealed that 84 per cent were markedly improved or cured as compared with 66 per cent so classified in the first series.

Hosmer¹⁰ reported the following figures as results of the same kind of treatment in 50 cases of chronic sinusitis: good, 62 per cent (relief of symptoms, diminution in the amount of nasal secretion, relief of nasal congestion, improvement in the color and tone of the nasal mucosa, and improvement in the general health); fair, 26 per cent (some improvement); no change in condition after adequate treatment in 12 per cent.

Considering that these were selected cases, all of whom failed to improve after extensive local, general, and surgical treatment, the results were very satisfactory. Hosmer considered that his experience was a more rigorous test of the treatment than Kracaw's series represented, since Kracaw used the method in all instances where it seemed indicated, while he did not use the antigen until all other procedures at his disposal had failed.

Treatment with the respiratory undenatured antigen must be individualized in order to obtain the best results. Moreover, permanent improvement requires a considerable number of treatments. Kracaw⁴ and Hosmer¹⁰ found that some cases did not improve until the seventh to tenth weeks of treatment.

In the writer's group of 40 patients a total of 1,151 injections, or an average of 29 injections per patient, were given. Four patients received from 60 to 80 injections each over a period of one year. Four who received less than 10 injections are eliminated in the final calculations. The average duration of all treatment in a given case was four months. Of the 36, there were 24 cases of ethmoiditis, 11 cases of pansinusitis, and one of sphenoiditis alone. Six were between the ages of 10 and 17, and 30 were adults.

The initial dose in each case was 0.1 cc. intradermally and 0.1 cc. subcutaneously. The subcutaneous dose was increased by 0.1 cc. at each succeeding injection until the tenth dose, the interval between treatment being three to five days.

Beyond the tenth dose the treatment continued at weekly intervals, using 0.1 cc. intradermally and 1 cc. subcutaneously.

The recommendation that the undenatured bacterial antigen be injected intracutaneously as well as subcutaneously is based on the conception of the skin as an immunologic organ. A great deal of experimental work has shown that stimulation of the cutaneous mechanism brings about an effective antibody response and a degree of response out of all proportion to the quantity of antigen injected.

At each visit each patient received the following treatment:

1. Two injections as mentioned above.
2. The nasal passages were cleared of pus, crusts or scabs, as the case might be, but no antiseptics were employed.
3. The turbinates were shrunk with a spray of 1 per cent cocaine hydrochloride unless the passage was already roomy.
4. The topical antigen was administered by Proetz displacement method, using 1 to 1½ cc. of antigen diluted with an equal quantity of a solution of one-half of 1 per cent ephedrine in physiologic salt solution. This proportion was used throughout in all cases.

In 1,151 injections only one reaction was reported, and this was following the nineteenth dose, or the tenth maximum dose. The temperature rose to 103.4° in 12 hours after injection and the arm was quite swollen and reddened from elbow to shoulder.

Both local and systemic symptoms were gone in four days. Possibility of contamination was remote.

No reactions nor ill effects were noted following topical treatment.

After repeated clinical examinations and determinations by subjective and objective study, the following figures are calculated from the 36 cases receiving over 10 injections: cured, one case; definite improvement, 17 cases; moderate improvement, eight cases; no improvement, 10 cases. Thus we find 72 per cent satisfactory or improved, and 28 per cent showing no improvement.

The one reported cure was a boy, age 10 years, whose mother explained that he had had profuse nasal and post-nasal discharge all his life. He received 80 intradermal, subcutaneous and topical treatments, and showed no improvement until the fiftieth treatment. He has remained free of any upper respiratory pathology for one year following completion of his course of treatment.

Among the 17 cases classified as definitely improved, one girl, age 12 years, had had atrophic rhinitis with profuse discharge and crusting. She received 72 treatments as described above. A severe attack of acute rhinitis appeared between the eighth and ninth treatment, after which she showed progressive improvement. The mucosa became more moist and although some discharge persists to date, she is more comfortable and is much better able to expel any collections.

In each of the 25 improved cases the patient expressed the feeling that he or she had been symptomatically relieved. In following these cases closely it was generally observed that nasal and postnasal drainage increased after the second to fourth treatment, and began to diminish after the eighth to twelfth treatment. The mucosa took on a more normal color and appearance, and any remaining discharge was less tenacious and less abundant.

Twenty-seven patients reported increased nasal and post-nasal drainage between the second and eighth treatment. Twenty of these were among the 25 later found to be improved.

Of the 10 unimproved cases, two reported that they felt better, both from a local and a general standpoint, but clinical examination failed to show any change. Of the other eight unimproved patients, three received less than 30 treatments. It is quite possible that one or more of these three might have improved with further treatment.

These results vary somewhat from those of Kracaw and Hosmer, but this is probably explained by the fact that the 40 cases used were strictly chronic suppurative cases. They were patients who had shown no response to any previous treatment, either medical or surgical.

CONCLUSIONS.

1. Seventy-two per cent of a group of 36 chronic suppurative sinus cases showed improvement under treatment with undenatured respiratory antigen.

2. Treatment of such cases with undenatured respiratory antigen is more promising than with any other treatment tried.

3. No untoward effects were noted except one local and general reaction in 1,151 injections.

REFERENCES.

1. ANSON, M. L., and MIRSKY, A. E.: On Some General Properties of Proteins. *Jour. Gen. Physiol.*, 9:169, 1925-1926; Protein Coagulation and Its Reversal. *Ibid.*, 13:121, 1929-1930; *Ibid.*, 14:605 and 725, 1931.
2. KRUEGER, A. P.: A Method for the Preparation of Bacterial Antigens. *Jour. Infect. Dis.*, 53:237, 1933.
3. WOMACK, D. R.: The Use of Undenatured Bacterial Antigen (Krueger). *THE LARYNGOSCOPE*, 45:554, 1935.
4. KRACAW, F. C.: Chronic Sinus Infection—A New Method for Its Treatment. *California and West. Med.*, 40:228, 1934.
5. KRACAW, F. C.: The Treatment of Chronic Sinus Infections with Undenatured Bacterial Antigens. *THE LARYNGOSCOPE*, 46:26, 1936.
6. HOSMER, M. N.: Report of Fifty Cases of Chronic Paranasal Sinusitis Treated with Undenatured Bacterial Antigens. *California and West. Med.*, 43:24, 1935.

1412 West Erie Avenue.

LIPOMA OF THE MAXILLARY ANTRUM.*

DR. CHARLES E. SILBERNAGEL, Columbus, Ohio.

On April 1, 1935, Mr. L., age 50 years, consulted me with the following history:

During the summer of 1934, while working in his flower garden, he developed what he thought was hay fever. He had never had hay fever, and the trouble was confined entirely to the right nostril.

After the occurrence of frost in the fall his symptoms did not improve and he consulted his family physician, who treated him locally and with an autogenous vaccine until April 1, when he came to me at the request of his physician.

The patient seemed to be in perfect health except for the chief complaint, inability to breathe through the nostril, and having a thin, watery discharge from the nostril. As far as could be determined, he has an absolutely negative family and personal history with the exception of the removal of a small lipoma from the posterior cervical region when he was 25 years of age, and his father had a large lipoma removed from the "neck" many years ago.

The mucous membranes of the right nostril were extremely intumescent, while the left nostril appeared to be normal. Upon transillumination the right maxillary sinus appeared dark as compared with the left. The frontals were normal. The ears, teeth and tonsils all in good condition.

In the X-ray a definite shadow was apparent in the lower part of the right maxillary sinus. The sinus was then irrigated, but the solution was returned perfectly clear. Lipiodol was then injected and another X-ray was made, this time for stereoscopic examination. This X-ray showed the lipiodal capping the less dense shadow which filled the lower part of the sinus.

Operation was then advised and on April 10, the sinus was opened through the canine fossa and a mass approxi-

*Read before the Academy of Ophthalmology and Oto-Laryngology, Columbus, Ohio, March 7, 1938.

Editor's Note: This ms. received in Laryngoscope Office and accepted for publication, March 14, 1938.

mately $1\frac{1}{2}$ by $1\frac{1}{2}$ by $2\frac{1}{2}$ cm. in size removed. This had the gross appearance of fat covered over by a thickened polypoid degenerated mucous membrane.

The first report from the frozen section was polypoid tissue, and, as I knew that could not be entirely correct, I placed in the cavity some radium which had previously been prepared for me. Just as the operation was completed, a second report came that the neoplasm was definitely a lipoma.

The patient made an uneventful recovery, with complete relief from his symptoms.

Now, as I thought lipoma was a peculiar growth to find in the maxillary sinus, I began to look for reports of similar cases, and I found but one. This was a case reported in *THE LARYNGOSCOPE*, in 1915, by Dr. Max A. Goldstein.

Dr. Goldstein's patient had a specific history, with a profuse purulent and offensive discharge of long standing from the nostril and also through a fistulous opening into the palate. Upon operation a lipoma was found completely filling the sinus. A large sequestrum of bone was removed from the floor of the sinus, leaving a permanent fistula into the mouth. This was covered by a dental plate. The patient received treatment for his lues and made a good recovery.

Whether the bony destruction was due to lues or to pressure from the lipoma was, of course, not stated.

In my case, the patient was seen early and the condition corrected before any bony destruction or foul purulent secretion occurred.

247 East State Street.

SURGICAL INDICATIONS IN SINUSITIS.*

DR. DANIEL S. CUNNING, New York.

In speaking of the surgical indications in sinusitis, we must take into consideration the acute and chronic infections, and their allergic manifestations. In acute sinusitis, the patient suffers from the same constitutional symptoms as in any other acute infection, due to the swelling of the mucous membranes of the sinuses, absorption of the toxins, or the bacteria themselves, or those produced by the action of the bacteria upon the tissues. There is very little to be said about the surgical treatment of acute sinusitis, except when we speak of the minor surgery in the treatment of an acute antrum or frontal. Antritis, we believe, is most often responsible for the delayed resolution in acute sinuses and if an acute infection of them lasts over a period of two weeks, we feel justified in investigating the antra by washing through the natural opening or under the inferior turbinate. It has been our experience that a great number of these cases are immediately relieved and started on their way to normal resolution.

Next is the acute frontal. It is our belief that many of these cases will resolve themselves, if we persist in palliative treatment long enough. Our palliative treatment consists of relieving the patient's symptoms by the use of heat, pron-tolyn and analgesics. There was a time not so many years ago when an acute frontal lasting two or three days was sufficient excuse for some intranasal surgery, and while perhaps we relieved some of these patients of their acute symptoms, nevertheless we did more harm than good and often started a chronic ethmoiditis, which eventually went on to a purulent hyperplasia with its attendant exacerbations. It is now our practice to make surgical intervention the last act in treatment, even though it be necessary to hospitalize the patients for a week or ten days in carrying out our non-operative treatment.

In an acute frontal, with its accompanying headache and pain over the sinus, fracture of the anterior tip of the middle

*Read before the New York Academy of Medicine, Section on Oto-Laryngology, Feb. 16, 1938.

Editor's Note: This ms. received in Laryngoscope Office and accepted for publication, April 22, 1938.

turbinate is routine with us, as it almost always relieves the pain by opening up the nasofrontal duct, thereby establishing drainage. Occasionally it is necessary to resect the anterior tip.

The most important complication of this particular phase of sinusitis is the subperiosteal abscess or orbital cellulitis, which sometimes results from acute ethmoiditis, particularly in children. The treatment of this condition requires a fineness of surgical judgment which cannot be overestimated, and requires that the Rhinologist call both on the laboratory and whatever other consultants he may have at his service if there is doubt as to the proper time for surgical intervention. We see a great variation in the relative severity of this complication, ranging from the slight edema of the eyelids, which subsides without any interference, to the extreme cases with severe edema, proptosis and fixation of the eyeball. Our procedure in this type of case has changed somewhat during the last decade. At one time we felt justified in proceeding surgically at the first sign of orbital involvement, and very often found what appeared to be a normal looking ethmoid and frontal without presence of pus. At present we watch these cases for a period of a week, ten days or two weeks, depending upon the condition of the patient's temperature, the amount of swelling, and the blood findings, etc., before interfering surgically. It is surprising to see how many of these cases will resolve themselves through the simple application of supportive treatment. Local treatment to the mucous membranes of the nose, such as hot saline irrigations and the irrigations of the antrum of the affected side, may be of great help. I believe that many cases of orbital edema in children are due to an extension of the inflammation from the antrum.

In these cases we pay more attention to the mobility of the eyeball than any other single symptom. When the eyeball is freely movable and the general condition of the patient is good, we watch and wait indefinitely. However, once the eyeball becomes definitely limited in its motion, we feel that an external ethmoid must be done, as it is but a question of a few hours when optic atrophy may ensue.

If it becomes necessary for surgical interference, we usually make an incision such as that made when doing an external

ethmoid, and the tissues are elevated along the Os planum and floor of the frontal until the abscess is reached and evacuated. In children we feel that this is all that is necessary in a vast majority of these cases. Unless we discover some gross pathology on the floor of the frontal, or the Os planum of the ethmoid, these areas are not interfered with. However, if we do find granulation present, we believe that nature is fighting a losing battle, and the perforation is due more to an erosion and infection of the bone than to a dehiscence or rupture of the frontoethmoid suture and feel justified in resorting to more radical procedure to establish drainage, *i.e.*, cleaning out the ethmoid. Our conservative treatment of these cases has been the result of observation of the incidence of osteomyelitis of the frontal bone with early and radical operative procedures in cases of acute ethmoiditis and frontal sinusitis.

In adults the story is different. We find in most cases of orbital infection that the infection is usually the result of frequent and severe exacerbations of a chronic purulent sinusitis with a definite perforation of the Os planum of the ethmoid or an extension of the disease through a perforation in the floor of the frontal. Very few cases of this type can be cured without a thorough exenteration of the ethmoids and the removal of the floor of the frontal.

CHRONIC HYPERTROPHIC PURULENT ETHMOIDITIS.

Chronic hypertrophic and chronic hypertrophic purulent ethmoiditis constitutes a large part of our rhinologic practice and gives us much trouble and taxes our judgment to its limit. It is responsible for more complications than any other type. The vascular and lymphatic changes present in the tissues, and the direct associations of the vascular system of the ethmoid and orbit account for much eye trouble. The conjunctiva, cornea, sclera, optic nerve and the intraocular tissues are likely prey for the toxins from this area. Very often the rhinologist is appointed, as the court of last appeal, as to whether or not surgical intervention shall be instituted or advised in such cases as retrobulbar neuritis, chorioretinitis, and other destructive lesions of the eye. In some cases we have no other alternative but to operate; in others, we will most likely arrive at our decision by process of elimination, with our own particular experience, knowledge and reasoning thrown into the balance.

Not so many years ago we operated on a great many sinuses for the cure of retrobulbar neuritis and our results were often disappointing, for the simple reason we believed that nearly all were due to sinusitis. Focal infection anywhere in the body may cause retrobulbar neuritis, such as teeth, tonsils, sinus, etc., but a fairly common cause that was nearly always overlooked formerly was multiple sclerosis. None of these cases should be operated on until we examine the patient and ascertain the presence or absence of the superficial abdominal reflexes. This is one of the earliest signs in multiple sclerosis, *i.e.*, absence of the superficial abdominals. Later on they present the classical signs; namely, increased knee jerks, nystagmus, scanning speech and intention tremor.

This is the type of sinusitis which is responsible in a large measure for the chronic cough of the so-called bronchitis. However, the quality of the cough will sometimes vary with the clinical findings of the sinusitis. Patients with a chronic, hypertrophic sinusitis without any tissue degeneration suffer from a mild cough reflex which is initiated in the pharyngeal and antral mucosa. These patients may have, on examination of the chest, some rales and rhonchi. Those who are suffering from the purulent type usually have a large amount of sputum, a bronchiectasis and severe productive cough.

There has been considerable controversy as to the value of operative procedures in these types of sinusitis for the relief of chronic bronchitis. My belief is, that in the cases of chronic hypertrophic sinusitis without tissue changes and secondary infection, the results are not encouraging. However, in chronic hypertrophic purulent sinusitis with thickening membranes throughout all the sinuses, together with secondary infection, the results are more encouraging.

In other words, if there is sufficient pathology in the nose to warrant operating, even though no bronchial conditions were present, then we would proceed to operate.

When operations are done for the relief of bronchial symptoms in these cases, it is necessary that they be complete and thorough, and as extensive as the pathology indicates. Any operation which does not thoroughly drain the sinuses is better left undone. In cases of bronchiectasis, sinus operations should be done, not with the idea of curing these patients, but with the hope that we may alleviate their symptoms.

The multiple dilatations of the bronchi in bronchiectasis are subject to exacerbations in ratio to the exacerbations and reinfections of the chronic sinusitis. We are most uncertain as to the precipitants of these infections, because while there is a constant stream of bacteria present in the inspired air, only at certain times does actual reinvasion take place. There may be exacerbations of chronic sinusitis without the exacerbation of the bronchiectatic inflammation. In exacerbations of the bronchial inflammatory state it may be necessary to resort to bronchoscopic treatment for the relief of the symptoms.

CHRONIC HYPERPLASTIC AND CHRONIC HYPERPLASTIC PURULENT SINUSITIS.

Considering the known pathology of this type of sinusitis and the excellent work of Eggston on the subject: "Pathology of Chronic Sinusitis," we feel there is very little to be said for the nonoperative phase of treatment. I realize that some writers have claimed excellent results through the medium of allergy, proper desensitization, food eliminations, endocrine imbalances, etc., but it has been my misfortune not to have had much success in this condition from these methods of treatment, nor has it been my good fortune to have seen many of the good results. We know that radium has been used in several different experimentations during the past 10 years, but has been discarded as being of little or no value in those polypoid cases which are complicated with asthma or bronchiectasis. We have failed to see any form of nonoperative treatment render any material benefit to many patients suffering from well established bronchiectatic or asthmatic symptoms. Hence, we have turned to operative treatment for results.

In speaking of the operative treatment, it is necessary that we establish the fact that we do not operate on many cases of asthma or bronchiectasis until they have been thoroughly gone over from the allergic point of view, and it is well established that the known nonoperative methods of treatment in this field can avail the patient little or nothing. Only then do we feel that we are warranted in starting with our most radical operative treatment.

The amount of operating done varies with the history, clinical and X-ray findings. Given a case of mild chronic bron-

chiectasis with a protracted cough, but not a large amount of bronchial secretion which shows on clinical examination a definite sinusitis without any secondary infections, the X-ray plates give evidence more of osteoperosis than otosclerosis—such a case, in our opinion, would do well with a double ethmoidectomy, enlargement of the sphenoid ostei and a double intranasal antrum. In extreme hyperplastic cases with considerable polypoid degeneration and with definite areas of sclerosis is the type of case for which we would advise the external route.

In these polypoid cases where the X-ray show a 4+ throughout all the sinuses, we feel an external operation should be done after the method of Lynch, endeavoring to be as thorough as possible in removing all infected material from the frontals, ethmoids and sphenoids. If the frontals are not involved or only to a slight extent, we do an intranasal pansinus operation. Here the question of dealing with the antra comes up. Most of the men on our clinic do the operation in two stages; namely, the frontal ethmoids and sphenoids at the first stage, and bilateral external antra as the second. Personally, I do it in one stage, but instead of the external antrum operation, I invariably do the intranasal. I feel that with a large intranasal opening the antral mucosa and polypi can be fairly well cleaned out by means of the Faulkner ring curettes. Occasionally it may be necessary to resort to the external route at a later date. Oftentimes the lower turbinate is boggy and polypoid, and in these cases we remove the middle third of it, leaving the anterior and posterior tips in place. If in a month or so they are found to be polypoid we remove them and as yet have noticed no untoward symptoms.

There has been a great difference of opinion among the rhinologists as to the value of surgery in these asthmatic cases. As I have already stated, these cases that have real pathology in their sinuses, demonstrated clinically and by X-ray findings, where their sinuses are filled with polypi, I believe have an excellent chance for great relief from their asthma and oftentimes a cure by thorough nasal surgery.

VASOMOTOR RHINITIS.

Vasomotor rhinitis may be termed another form of hay fever, inasmuch as the symptoms are practically the same

and these two conditions are often the forerunner of a chronic hyperplastic sinusitis. Eosinophilia may be present in hay fever as well as in vasomotor rhinitis, and the nasal mucous membrane may appear identical. The only differentiating facts are that vasomotor rhinitis is a perennial disease and the clinical history of the patient may suggest a clue to the allergens responsible for the reactivity in many cases. These allergens may be inhaled or they may be ingested in the form of foods. These may also be a biochemical imbalance brought about by an absence of sodium or potassium salts. This imbalance seems to play an important part in predisposing the individual to hypersensitivity. So definitely has this condition been established that at the present time there is considerable investigation going on, and some men are beginning to recognize the acid and alkaline individuals by the color of their nasal mucous membranes. Jarvis has done some fine work on this subject by testing the reaction of the urine and saliva, and increasing or decreasing the intake of proteins and carbohydrates.

The pale, swollen membranes of the nose are interpreted as indicating a condition of the body fluids which might be termed as alkalosis; whereas, the red, dry, glistening membranes are indicative of an acidosis, which is merely a relative acid stage, for cell life could not continue if the fluids became neutral entirely or less acid. In the first, the sodium and chlorides are deficient and the body may be in need of sodium chlorides or a dilute acid. If the membranes are red, potassium and calcium and the iodides are deficient.

While therapy along these lines has been of great help in the treatment of these cases, we cannot hope to cure them or relieve their symptoms entirely unless we pursue our investigations sufficiently to determine the allergens causing the local manifestations. These patients are very often helped by such simple precautions as the removal of animal or vegetable contact or the elimination of certain articles of food from their diet. The surgical treatment in cases of this type is limited, of course, to the removal of nasal obstruction in the form of deviated septi, hypertrophied turbinates and the removal of enlarged posterior tips of the inferior turbinates.

And so we bring this paper to a close with the conclusion that the sinuses must often be taken into consideration in

solving our problems in general medicine and that while there has been great improvement in the treatment of sinusitis from the standpoint of immunology, nevertheless, operative treatment has gone a step further in the right direction, offering some of these patients marked improvement when they have been given up by the immunologist.

145 East 54th Street.

MINNESOTA ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY.

SECTION OF OTO-LARYNGOLOGY.

Meeting of Oct. 8, 1937.

Pemphigus of the Larynx. Case Report. Dr. John J. Hochfilzer.

This patient, a male, age 69 years, was seen for the first time on Aug. 7, 1937, in the Ear, Nose and Throat Section, of the Out-patient Department, at the Ancker Hospital, giving the following history:

In December, 1936, he had a bad cold, with hoarseness, sore throat, slight dysphagia. The cold gradually subsided, but the hoarseness continued. During the past six months he has had transient spells of aphasia followed by periods of hoarseness. Since the onset of his hoarseness, he has had an intermittent cough, expectorating slimy material, yellowish in color, containing much mucus; it has never been bloody.

About two months prior to his admittance to the hospital, patient noted a skin lesion on his right hip. This appeared as a little blister about one-half inch in diameter; it was filled with a watery fluid, slightly yellowish in color. Similar lesions appeared on the legs, and one on the antero-lateral surface of the left side of the trunk. They were not painful, nor did they itch, and healed with local scaling. They appear independently, are not confluent and usually appear one at a time; there are a few similar lesions on the arms. About two months ago, patient noted lesions in his mouth; these first appeared on the left buccal mucosa and then on the right; two appeared on the palate, which healed up in a few days and were only slightly painful. There is a lesion beneath the tongue which comes and goes, is occasionally painful and is white in color.

His past and family history are unimportant.

Physical examination revealed the presence of large and small skin lesions; they are distributed symmetrically over the body in the following areas: the upper half of the back, lower extensor surfaces of the arms, upper one-half of the chest, anterior surface of the forelegs; besides these areas, there are singular lesions near each hip joint and one on the sole of the right foot. These lesions are for the most part discrete; these dry up in a period of hours and crust. Each is surrounded by a fairly large area of inflammation, which is bright red in color, and they scale finally; the skin peels and the inflammatory area disappears. The sites afterward are followed by a thin, shiny skin and the area is pigmented. Lesions of all ages are seen, the bullous type predominating.

Examination of the mouth shows, on the left buccal mucosa, opposite former position of molar teeth, a healed lesion, which shows some scarring and a smooth surface. On the right buccal mucosa and at the base of the tongue, near the left side of the frenulum, are two large areas covered with a thick, creamy, yellow, tenacious substance; when removal is attempted, the underlying area shows a clearly ulcerated surface, which bleeds easily.

On the hard palate, islands of beefy red, indurated areas can be seen. Direct and indirect larynx examinations revealed no limitation of motion of the vocal cords; but the mucous membrane of the entire larynx was markedly inflamed and thickened; several areas were ulcerated, others again covered with membranous exudate of grayish color; the loss of substance in the ulcerated areas was confined to the mucus membrane itself, and did not include the submucous structures; at no place were any signs of proliferation.

At the time of our first examination, we were at a loss with regard to the diagnosis. Our first thought was tertiary lues; however, repeated examinations of the blood and spinal fluid showed a negative Wassermann. Physical and X-ray examinations of the chest, as well as sputum examinations, were negative, thus excluding any tubercular manifestation, and certainly it did not present a picture of any proliferative, malignant process; finally, the skin lesions which pointed to the possibility of pemphigus were detected. Dr. Madden then saw the case and confirmed our diagnosis.

Pemphigus is an acute or chronic disease of the skin and mucous membrane, occurring in several places and often accompanied by constitutional symptoms. (It is characterized by bullae, which develop in cycles or in continuous succession.) Various types are recognized: acute infectious pemphigus, pemphigus vegetans, pemphigus foliaceus, and pemphigus vulgaris; the latter is the common form of the disease and the one that applies to our case.

Symptoms: The lesions of pemphigus are bullae of various types and their sequels. The lesions may be located on any part of the body. The mucous membranes, face, neck, extremities and trunk are all invaded to a greater or lesser degree. The bullae occur in successive groups or continuously. They may be widespread or comparatively limited. There may be periods of intermission or remission. In the common forms, the bullae are usually tense and contain clear serum. The bullae may disappear by rupture and the formation of crusts, or they may undergo involution without rupture.

Etiology: The theories formerly held as to the origin of the disease have been the neuropathic, toxic and infectious. In Europe, males apparently are affected more commonly than females, but the reverse seems to be true in this country. It has been observed not infrequently in debilitated patients who are suffering from neurasthenia, worry and exhaustion, visceral disorders and impairment of nutrition. The neuropathic origin is held by many, but the proof in most cases is lacking. The opinion of many competent observers now is that the disease is of toxic origin, the nature of which is not yet explained.

Diagnosis: Pemphigus is to be differentiated from other bullous disorders, such as lepra, syphiloderm, bullous impetigo, and erythema. (The appearance of the eruption on the mucous membrane is characterized by the formation of a bleb, varying in size, filled with a yellowish fluid. This bleb finally ruptures and a milky white membranous deposit remains.) According to Chiari, the bullae are the result of rapid exudation. On account of the rapid appearance and collapse of the bullae, one may never have the opportunity of seeing these eruptions in the mucous membrane; the diagnosis has to be made from the appearance of the collapsed membrane. The most frequent sites are on the cheeks, gums, faucial pillars, and epiglottis. According to New, in severe cases the mucous membrane of the mouth, pharynx and larynx may to a great extent be covered with a beefy red ulceration with fibrinous exudate. A slight inflammatory reaction occurs around the lesions, with projections or islands of the normal mucous membrane extending into the ulcerated area; this description fits very well to our case. Usually these lesions do not leave any scarring.

Progress and Prognosis: Some writers state the prognosis is favorable if the lesions are confined to the mucous membrane only, but if associated with lesions on the skin the outcome is fatal; the lesions may persist for years, with intermissions of improvement.

Treatment: Local applications have no influence whatever, except for easing the irritation. Intravenous salvarsan injections and subcutaneous injections of sodium cacodylate are usually of only a temporary benefit.

DISCUSSION.

DR. JOHN MADDEN opened the discussion of Dr. Hochfilzer's paper. Dermatology is a comparatively small medical specialty, and pemphigus is a rare disease among dermatologists. This condition constitutes less than 1 per cent of the skin diseases. Pemphigus is a disease that is characterized by spon-

taneous remissions and exacerbations, so therapy may seem effective but, actually, is not. Most pemphigus patients consult dermatologists rather than otolaryngologists because the greater number of lesions usually are on the skin. Most of the patients have both skin and mucous membranous lesions, although they may have either alone for a number of years. The etiology is unknown and the outcome is fatal, so there is very little left to say about therapy. The patients live for a period of months to a number of years, with a final fatal outcome. The patient loses weight and falls prey to almost any infection, especially pneumonia. One of the older therapeutic agents was arsenic given by mouth. Later, when neosalvarsan and salvarsan came into use, any number of favorable results were reported from the use of these drugs. Some patients were given temporary relief, but if followed over a period of years they would sooner or later have exacerbations and die. That is true of almost all therapeutic agents used. The more recent treatments used are malaria or typhoid fever therapy, tryparsamide, and germanin. For the moment, very startling results are appearing in the literature following the use of germanin. However, we feel that there has been no satisfactory cure for pemphigus, and the things we use probably only give patients temporary remissions that might have occurred without any treatment.

DR. KENNETH A. PHELPS said he was very glad to have the opportunity of examining this patient. It seemed to him one point should be emphasized, and that is prognosis. Here is a patient with a small lesion, maybe only a blister, or the spot where the blister opened, limited to the epithelium, for this disease seems to be entirely epithelial: not a very suspicious looking thing, but a fatal disease. We should not be caught off guard any time we see such a lesion; we will not tell the patient to go home and forget it and take a mouth wash. It would save embarrassment if we would think of pemphigus and remember it kills people.

DR. VIRGIL SCHWARTZ asked Dr. Madden if pemphigus is more fatal in infants and children than in adults.

DR. MADDEN answered that he has never seen a case of pemphigus in an infant or in a small child. In the combined experience of dermatologists in both cities, they see only about five cases a year. This is the first case they have had at the Ancker Hospital in three years.

Laryngeal Obstruction. Dr. F. D. Hurd.

Definition: The meaning of this term as used here is that condition which hinders the normal free passage of air through the glottis.

Incidence: The incidence varies, depending upon the type of cases which are usually admitted to the institution. A large municipal hospital with a busy contagion service will see more of the acute serious laryngeal obstructions, while in institutions like the University Hospital, where the patients are transported many miles, we are inclined to see a slower progressing type of obstruction.

At the University Hospital in the past five years, 71 cases needed relief from serious stridor or it was considered necessary to treat the patient as such, in anticipation of a serious obstruction. In the treatment of these 71 cases, 70 were tracheotomized and one was intubated. In regards to the tracheotomy, these are frequently done as an elective procedure in preparation for laryngeal obstruction.

Roughly speaking, one-half of the 71 cases were carcinoma of the larynx; nearly one-half of these were of an elective nature, as no particular obstruction existed at the time of the tracheotomy.

One-fourth of the cases were for the relief of laryngeal obstruction due to tumors of nearby structures, such as tongue, esophagus, pharynx.

Four cases were due to infection with or without abscess formation, and were of a very urgent nature.

Two cases were necessary because of bilateral abductor paralysis of the vocal cords, following thyroid surgery.

Two cases were for trauma following bronchoscopy done in about 290 bronchoscopies.

Two cases were for treatment and relief of acute laryngeal-tracheal-bronchitis.

One case each of tuberculosis, syphilis, leukemia, pressure on the trachea due to enlargement of the innominate artery and another due to the same cause from enlargement of the thyroid gland.

Treatment of laryngeal obstruction is, of course, to remove the cause of obstruction or, by artificial means, to carry air to the trachea below the point of obstruction.

The narrowest point in the lumen of the respiratory tract above the bifurcation is at the level of the vocal cords or at the so-called glottic chink. It is at this point that the most frequent cases of laryngeal obstruction are found.

In the treatment of laryngeal obstruction, two methods are usually recognized: 1. Tracheotomy; 2. intubation.

1. Best for the short period of time. 2. Air is heated and humidified as taken into the lung. 3. No chance of stricture of trachea as might follow a badly placed tracheotomy. 4. Can be utilized in short order where tracheotomy takes precious moments.

Advantages of Tracheotomy: 1. It is possible to facilitate drainage from a trachea, as in tracheobronchitis, and through the opening solutions can be introduced. The bronchoscope can be used through the opening, avoiding injury to the tissues at the glottic chink. 2. By placing moist gauze over the opening or keeping the patient in a warm room with plenty of steam takes care of the heating and humidifying the air. 3. Tracheotomies are always done low, the only exception being in anticipation of a laryngectomy, where it is best to preserve the upper part of the trachea; therefore, stricture following tracheotomy should never occur. 4. Experiments have shown that tracheotomy wounds can be kept open for months and then will heal without encroaching upon the lumen of the trachea. 5. It is found that children will eat and drink much better with a tracheotomy tube in place than when an intubation tube is used.

We feel that there are some cases in which an intubation is indicated, while in a greater majority of cases a tracheotomy is preferred in the treatment of laryngeal obstruction.

In introducing the intubation tube, those who have had a great deal of experience recommend the use of the laryngoscope, and the introduction of the tube under direct vision.

The tracheotomy is done either in an orderly or an emergency manner. For the emergency at the hospital, a small kit is always available for a tracheotomy. This kit contains, besides the necessary equipment for doing a tracheotomy, a Mosher life-saving tube and different intubation tubes. In the orderly process of tracheomatizing a patient, there is sufficient time to set up the operating room, prepare and properly drape the patient. One per cent novocaine is injected in the midline at a point about one-half the distance between the cricoid cartilage and the suprasternal notch. This injection is extended upward, but principally downward for an extent of about 4 cm. Care is taken to stay in the midline and below the isthmus of the thyroid. When the trachea is exposed from the second to the fourth rings, a few drops of cocaine are injected into the trachea. Then, either a horizontal or a vertical incision, a little over 1 cm. in length, is made in the trachea, and a round button-like piece removed. One-half, on each side of the slit, a good sized opening is made in the trachea and a liberal sized tube is used. There is no evidence that there is any difference in the healing of a small sized opening from that of a larger one. Unless the incision is unusually long, suturing is not necessary.

At the bedside, suction through a soft rubber catheter is kept close at hand. Steam and frequent cleansing of the inner tube is very necessary. The entire

tube is changed every 24 hours. Good nursing care and careful observation, especially during the first 24 hours, is very necessary.

The mortality in the use of tracheotomy in the treatment of laryngeal obstruction is no larger than in any other procedure, as shown by our results here at the University Hospital, where no patient has died directly following a tracheotomy; where, on the other hand, many of the patients have lived comfortably for years with a tracheotomy opening. On questioning the patients, we have found that the tracheomatized patient does not get respiratory infections or pneumonia any more frequently than the average person.

1. The low incidence of laryngeal obstruction, requiring surgical relief, such as intubation here at the University Hospital, is due to the fact that few cases of diphtheria or other contagious diseases are admitted. About one-quarter of the tracheotomies done at the University Hospital are for a greater or lesser degree of obstruction. 2. Direct laryngeal examination with smears and removing of obstructing secretions are important in laryngeal obstruction. 3. In all fatal cases associated with tracheotomy, from two to six days following, were cases of some serious illness, and the laryngeal obstruction was secondary. 4. Prolonged wearing of the tracheotomy tube does not make one more susceptible to respiratory infections. 5. The most common cause of laryngeal obstruction, especially in acute conditions, is diphtheria and nondiphtheritic laryngo-tracheobronchitis. 6. More attention is being paid to the latter condition and its treatment. Solvents for the glue-like secretions are introduced through the tracheotomy opening and suction utilized. 7. The seriousness of the situation should be realized in all cases of croup and early adequate care arranged. The use of warm, humid air is universally advised, while the use of atropine and opiates are condemned.

(To be continued in a succeeding issue.)

BOOK REVIEW.

Surgical Anatomy of the Head and Neck. By John Finch Barnhill, M.D., F.A.C.S., LL.D. Formerly Professor of Otolaryngology in the Indiana University School of Medicine. Emeritus Professor of Surgery of the Head and Neck. Formerly Chief of the Department of Head and Neck Surgery in the Indiana University Hospitals; Honorary Professor of Anatomy, University of Southern California School of Medicine. Introduction by Paul S. McKibben, Professor of Anatomy in the School of Medicine, University of Southern California. Cloth. Royal 8 vo. of 921 pages, with 431 illustrations. Baltimore: William Wood & Company, 1937. Price \$20.00.

This book represents the opus magnum of a life devoted largely to teaching the special anatomy of the head and neck. Dr. Barnhill has always had the gift of being able to describe anatomy from the angle of the man who was going to use that information; that is, from the standpoint of the surgeon, and this gift has probably contributed largely to the marked success that he has had as a clinical teacher.

To the man who is interested in exact anatomic relationships about the nose, throat, or ear, or especially to one who enjoys the borderline relationships, the neck or contiguous intracranial regions, this book will contribute much.

All in all, it is the most important publication of its kind that has appeared in the English language in several decades, and we recommend it to every man who is interested in otolaryngologic surgery.

A. M. A.

